Guide to . . . Farm Practice in Saskatchewan

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AN AUTHORITATIVE AND PRACTICAL HANDBOOK ON THE PRODUCTION PROBLEMS OF SASKATCHEWAN AGRICULTURE

Prepared jointly by representatives
of the
UNIVERSITY OF SASKATCHEWAN
the
SASKATCHEWAN DEPARTMENT OF AGRICULTURE
and the
EXPERIMENTAL STATIONS, RESEARCH LABORATORIES AND OTHER SERVICES OF THE DOMINION DEPARTMENT OF AGRICULTURE IN SASKATCHEWAN

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Dedicated to

SASKATCHEWAN'S FARMERS, HOMEMAKERS, AND RURAL YOUTH

upon whose industry, good husbandry and good citizenship rests the success and progress of Saskatchewan agriculture.

Obtainable from
DEPARTMENT OF EXTENSION, UNIVERSITY OF SASKATCHEWAN.
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Foreword

FOR years a wealth of agricultural information based on research, experimentation and practice had been available from many sources in Saskatchewan, but not until 1928 was a definite attempt made to co-ordinate and consolidate this information and put it into readily usable form for the benefit of farmers. In that year representatives of the University of Saskatchewan, the Saskatchewan Department of Agriculture and the Dominion Experimental Farm System in Saskatchewan met in conference and prepared and presented practical reports and recommendations on the major problems of crop production in this province. These recommendations were then made available for Saskatchewan farmers.

The benefits accruing from this conference were such as to prompt the decision that it be held periodically, and it became known as the "Agronomy Conference," the reports submitted being published and distributed widely as a bulletin entitled "Guide to Crop Production in Saskatchewan."

In 1932 a comprehensive plan was drafted by the Dominion Minister of Agriculture to co-ordinate on a national scale all government services, both Dominion and Provincial, available for farmers. This plan involved a National Advisory Committee and a co-operating Advisory Committee in each province. The Saskatchewan Advisory Committee was named early in 1933 and the Agricultural Conference in January of that year was held under the direction of this Committee. Under the new plan the Conference dealt with every phase of agricultural production and the 1933 report went out under the broader title "Guide to Saskatchewan Agriculture."

Agricultural conferences have since been held in January, 1936; January, 1939; March, 1942, 1945, and 1948. On each occasion the resulting "Guide" has represented a revision of the previous material and has contained as well new information which it was considered would add to the usefulness of the publication. In the preparation of the 1939 Guide so much general agricultural information of merit was presented that it was felt expedient, in order to keep the publication within reasonable limits, to include only such material as concerned farm practices and in furtherance of this policy the title of the publication was changed to "Guide to Farm Practice in Saskatchewan." The 1942, 1945, and 1948 Guides have been published under the same title.

As before, the Guide represents the pooled findings and recommendations of the technical workers in agriculture in this province and as such forms an authoritative and practical, but necessarily brief, handbook on the production problems of Saskatchewan Agriculture.

The publication of the Guide is financed jointly by the Dominion and Saskatchewan Departments of Agriculture.

Guides Published

March	1933	12,000 copies
May	1936	27,500 copies
April	1939	35,000 copies
June	1942	35,000 copies
October	1945	50,000 copies
October	1948	50,000 copies

CLIMATE*

General Characteristics. — The seasonal weather of Saskatchewan is determined largely by the relative frequencies of invasion of three different types of air masses, namely: Polar Continental air (PC) from the region between Alaska and Hudson Bay; Polar Maritime air (PM) from the northern part of the Pacific Ocean, and Tropical Maritime air (TM) generally from the Gulf of Mexico and the subtropical latitudes of the Atlantic Ocean. Each air mass, while it is over its source region, acquires certain physical properties. PC-air is cold, dry and stable, the stability resulting from the greater cooling of the layers of air next the ground than of those at higher levels. PM-air is cool, moist and comparatively stable. TM-air is warm, moist and generally unstable. As each air mass moves away from its source region the characteristic properties, particularly in the lower layers, are changed by the land and water surfaces over which it passes. Cool air in passing over a warmer surface is heated and tends to become unstable; warm air in passing over a colder surface is cooled and tends to become stable. Dry air, if it is becoming unstable, evaporates moisture from the surface and thus becomes moist; warm moist air, if it is becoming unstable, is subject to thunderstorms and thus loses moisture.

Winter invasions of Saskatchewan by PC-air are responsible for the cold waves when temperatures often drop to values as low as –50°F. On the other hand, invasions of PM-air in winter are responsible for the mild periods when temperatures may rise sufficiently to melt the snow. Neither brings much moisture, the PC-air because it is inherently dry, and the PM-air because it loses its moisture in crossing the Rockies. Whether a winter is exceptionally cold or mild depends on the persistence of the invasions of the one type or the other. In the summer months the PC-air on reaching southern Saskatchewan is becoming unstable, and as a result evaporates far more moisture than the accompanying low temperatures suggest. The clear skies and the relatively low moisture content of this air mass make possible the radiation of much heat from the surface during the night, the temperature sometimes dropping to below the freezing point. Occasionally PM-air on reaching the Prairies in spring and early summer is becoming unstable. This tendency along with its dryness leads to severe dust storms. The instability helps to lift small soil particles into the atmosphere where they are carried forward at relatively high velocities by the wind and driven against the surface of the soil, breaking loose many more particles that are lifted in turn and carried forward by the wind.

Precipitation on the Prairies is dependent on the arrival of warm, moist air masses from the South. During the summer months the prevailing wind directions favor the transport of TM-air into the interior of North America and as far north as Saskatchewan. Generally TM-air is stable when it reaches Saskatchewan, little precipitation of the conventional or thunderstorm type occurring within the air mass. For a widespread rainfall colder and thus denser PC-air must push southward underneath the TM-air, or warmer and thus lighter TM-air must push northward over PC-air. In either case the TM-air is lifted, the lift causing the air to cool to temperatures suitable for the condensation of its moisture. Many of the severe droughts over the Prairies have resulted not from a lack of air with an ample store of moisture but from a failure of PC-air to push southward to give the necessary lift.

Seasonal Foreshadowing. — Reliable forecasts of seasonal weather cannot be made until far more is known about the physical mechanisms in the atmosphere that control the movement of air masses. Numerous studies involving much labor and expense, were made on this problem preceding World War II without attaining results of practical value. These investigations were continued with increased vigor during the war but significant results (if any) have not been made public. In any case it should be noted that a considerable number of stations have been established across Canada for measuring pressures, temperatures and humidities in the upper atmosphere by means of radio devices that are carried aloft by balloons, and that data from these stations may make possible the extension of the present 24-hour forecast to one for several days.

*Prepared by Department of Physics, University of Saskatchewan.

The tendency for a particular weather type to persist is sometimes overlooked. Contrary to popular opinion the longer a dry period or a wet period or a cold period lasts the more likely it is to continue. Examination of the climatic data for Saskatchewan has failed to show that the rainfall of the growing season is preceded by particular types of weather. Wet summers occur as frequently as dry after a fall with frequent fogs, after a fall or winter with heavy precipitation, and after a winter with lower than normal temperatures.

For several years before and after a sunspot maximum the rainfall and temperature in Western Canada average slightly below their long-time average values. Notable exceptions from this rule have occurred in certain localities and for particular years in all localities. At the present time (1948) the current cycle has apparently reached a maximum, a maximum that is much larger than any observed maximum since sunspot counts were started. Some progress has been made in predicting the time that either a sunspot maximum or minimum will occur, although the length of a sunspot cycle may vary in length from 9 to 14 years. No great importance should be attached to variations of precipitation and temperature associated with sunspots, since these are small in comparison with the seasonal variations that result from other causes.

Climatic Trends.—The average temperature of the winter months has increased steadily during the past forty years. This tendency toward higher temperatures has now spread to the fall months with the result that the frost-free period has lengthened. Data from a few places with long weather records indicate that the growing season has lengthened from five to twelve days during the past twenty years. This change should not be considered a permanent one.

A considerable increase has taken place in the average rainfall for the Province during the past ten years, although it is still below the long-time average from 1900 to 1940. Since there is no known reason for believing that our climate has permanently deteriorated further increases may be expected. The effectiveness of the precipitation has steadily decreased during the past forty years. A gradual rise of the average temperature has increased evaporation. Increased wind velocities because of the decreased frictional drag through the cultivation of grass lands, the clearing of scrub lands and the close cropping of pastures have also increased evaporation. The loss of organic materials from cultivated soils has increased the run-off over certain types of soil, the seepage through other types.

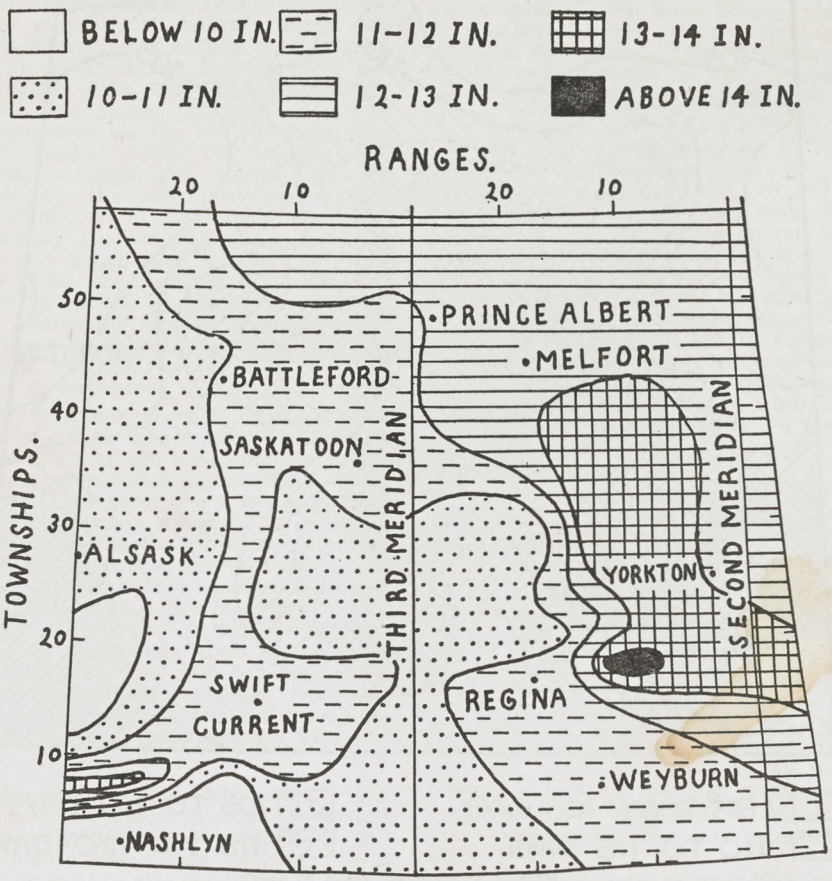
At Saskatoon during the past nine years the average wind velocity and the number of strong winds and gales, (especially in April and May), have been below the corresponding values for the decade starting with 1929. This decrease, together with the improved moisture conditions, have probably been more responsible for decreased soil drifting than counteractive methods of cultivation.

Precipitation.—Much detailed data on the monthly and annual precipitations are given in the bulletin, "Rainfall Records for Saskatchewan," which can be obtained on request to the Extension Department, University of Saskatchewan. A map, taken from this bulletin, is included with this summary, and shows the average precipitation from April 1 to November 1. The precipitation during the balance of the year is largely in the form of snow, and in terms of precipitated water amounts to about one-fifth of the values shown on the map. This quantity may actually be somewhat smaller. Recent measurements made at the University of Saskatchewan on the density of newly fallen snow indicate that about fifteen inches of snow are equivalent to one inch of water instead of the ten inches in current use. For the Province as a whole about eleven years out of twenty have rainfalls less than the yearly average. This is because a few years with exceptionally heavy rainfalls raise the average value somewhat higher than the observed values for one-half of the years. Alternatively the median precipitations, or precipitations for which one-half of the years of record will have higher and the other half lower values, are about one inch lower than the average precipitations shown on the accompanying map.

In most years snowfall is of little value in the production of grain crops. Winds remove much of the snow from cultivated fields. The water from the remainder runs off over the frozen ground in the spring. Excellent crops result only when ample rainfall coincides with the long hours of sunlight and the high temperatures of summer. Attempts have been made to catch and to hold drift-snow by ridging the snow. Considerable success may be anticipated on stubble land and on fields used

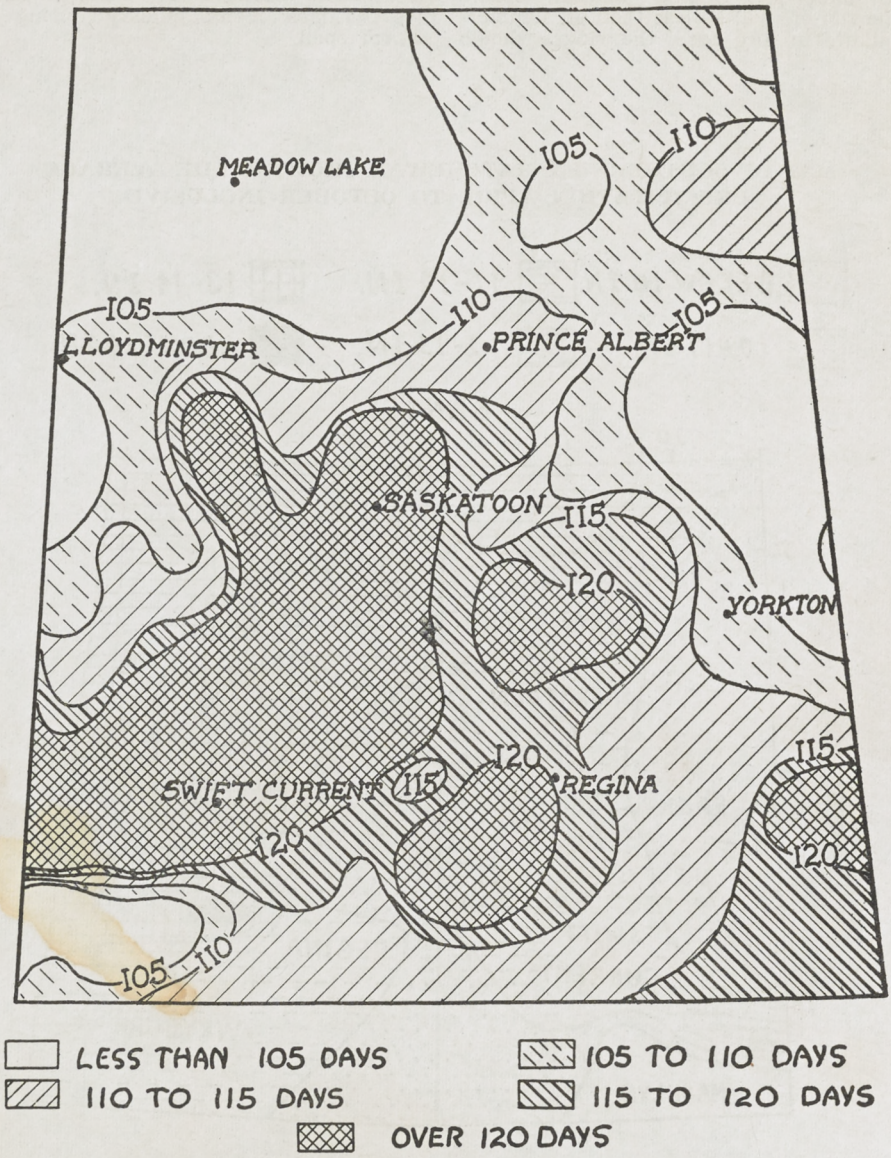
for hay and pasture. In both cases considerable snow will lodge and be available for ridging, and in spring the run-off will be less than on summer-fallow. In any case, the ridges should run north and south, partly because the prevailing winds are from the west and partly because the snow in east-west ridges melts quickly during a warm spell.

MAP OF SOUTHERN SASKATCHEWAN SHOWING THE AVERAGE PRECIPITATION APRIL TO OCTOBER INCLUSIVE



This map is from Bulletin No. 18, "Rainfall Records for Saskatchewan," published by the Extension Department, University of Saskatchewan, and outlines the districts where the average precipitation from April to October is similar. Roughly, the precipitation zones are diagonal across the southern part of the Province. There is an area of increased precipitation in the southwest where the Cypress Hills rise about 1000 feet above the surrounding country. From this area there extends northward a belt of more favorable rainfall than that prevailing in the surrounding districts. The area of highest precipitation is in eastern Saskatchewan with the maximum centering in the vicinity of Qu'Appelle. It is possible that small areas within each precipitation zone may, due to local conditions, have rainfall higher or lower on the average than that shown in the above map.

AVERAGE LENGTH OF PERIOD IN DAYS BETWEEN THE LAST KILLING FROST OF SPRING (29° FAHR.) AND THE FIRST KILLING FROST OF FALL



SOURCE—"Agriculture, Climate and Population of the Prairie Provinces of Canada." A Statistical Atlas by the Dominion Bureau of Statistics, 1931.

There are many local variations in the duration of the period from last killing frost in the spring to the first in the fall, but in general this period is ten days to two weeks shorter in the northern part of the settled area of Saskatchewan than in the south. On the plains in southern districts killing frosts are usually over about 15th of May. The last killing frost occurs on an average about two weeks later in eastern Saskatchewan following a range of hills and in northwestern Saskatchewan in the hilly territory about the creeks flowing into the North Saskatchewan River.

Rain-Making. — Newspaper publicity concerning experiments on precipitating moisture from clouds has led many people to believe that means are now available for eliminating drouths. This is not the case. For these methods to produce any appreciable quantity of rain, suitable clouds are required. These clouds must be several thousands of feet in thickness so that their tops extend to levels where the temperature is 30 to 40 degrees below the freezing point of water. On such occasions the tops of the clouds consist of super-cooled water particles which will change to ice crystals, if suitable nuclei are added. Either solid carbon dioxide (dry ice) or silver iodide crystals will act as nuclei. Once the ice crystals are formed, the water particles evaporate and condense on the ice particles. The added weight causes the ice particles to fall through the clouds, gaining weight by the continued evaporation and condensation of water particles. Eventually the ice and snow particles melt and reach the ground as rain-drops. The same rain-making process occurs in nature by the cloud growing to a somewhat greater height where the lower temperatures cause the ice crystals to form on nuclei that exist in the atmosphere.

The frequency with which clouds grow to a size where this "triggering" effect can and is necessary in order to produce rain is not known for Saskatchewan. As pointed out in the section on precipitation, rainfall in Saskatchewan requires the presence of warm moist air and the flow of colder air to lift it. Basically a cloud cannot be formed without the necessary water vapour or without a lifting process. Many of the clouds that are present over Saskatchewan are relatively thin and no amount of "seeding" with dry ice would produce sufficient precipitation to warrant the necessary expenditures.

Hail Storms and Tornadoes.—Hail storms occur more frequently during summers with heavy rainfall, since the atmospheric conditions causing their development are also conducive to heavy rainfall. Such storms usually start in the late afternoon and travel eastward, often until late at night or early in the following morning. The path of greatest destruction is seldom more than four to six miles wide, but may be several hundred miles long. The storms may occur at any time during the growing season, but are seldom very violent except in the last week of June, all of July and the first two weeks of August. The region lying south of the main line of the Canadian Pacific Railway and eastward from the Cypress Hills experiences such storms with greater frequency than other parts of the Province. The northeast and east-central portions suffer the least damage.

Tornadoes are apparently more frequent than was at first supposed. Their paths are narrow and short, so that the probability of damage to buildings is small. Only two cases are known where such storms have struck places of considerable size, namely, Regina in 1912 and Kamsack in 1944. Occasionally the reported damage to farm property leaves little doubt that a whirling storm of the tornado type was responsible.

Frost.—The period in days between the last killing frost of spring (29° F.) and the first killing frost of fall is shown on the accompanying map. This period is about two weeks longer than the period between the last frost of spring (32° F.) and the first frost of fall. The former period is significant for grain crops, the latter for small fruits and tender garden stuff. Actually the frost free period at any particular spot is very dependent on the topography. The cold air from the high land and the slopes drains into the low spots, and these may have frost in every month during the year.

The average date of the last spring frost (32° F.) is approximately June 1, for the eastern portion of the Province from the Churchill River south to the United States boundary; June 7, for the northwestern portion from the main line of the Canadian National Railway to the height of land between the Saskatchewan and Churchill drainage basins, and for the Cypress Hill country; and May 27, for the remainder of the grain-growing area. For most of this region the last frost has occurred as early as April and as late as July. Fifty per cent. of the last frosts have occurred within a period of about 18 days centred on the aforementioned dates.

The average date of the first frost of fall (32° F.) varies from August 28, for the Cypress Hills and the northwestern region, to September 9, for the northeastern region between the Saskatchewan and Churchill rivers. The later occurence in the northeast is due partly to the decrease of altitude and partly to the large number of small lakes and ponds, both of which tend to lengthen the frost-free season. For

practically all of the settled region of the Province the first fall frost has occurred as early as the first week of August and as late as October. Fifty per cent. of the first frosts happen within a period of about 20 days centred on the previously mentioned dates.

The Dominion Weather Service now issues very reliable warnings of late spring frosts and early fall frosts. These are included in the radio broadcasts of weather at times when frost is imminent. In case an individual is unable to listen to the weather forecasts, he should acquaint himself with the weather conditions that usually precede such events. On a day before a night with frost the temperatures are lower than normal because of an outbreak of PC-air; considerable cloud prevents the sun from warming the surface; and toward evening the sky clears and the wind drops. Showers sufficient to dampen the surface increase the probability of frost. On the other hand, if the surface is wet from a recent rain, damaging frosts are unlikely. Whenever a frost is probable, garden stuff and small fruits can be protected by light coverings. These should be placed over the plants in the early evening before much heat has been lost from the plants and from the soil below them. The best site for a garden, in order to escape damage from frost, is a slope facing the prevailing wind. The cold air drains away to lower levels, and the wind (usually very light in such cases) mixes warm air from aloft with the cold air at the surface. Hollows in level fields and the bottom of valleys with poor air drainage should not be selected. Shelterbelts around the farmstead with an open side toward higher ground allow cold air to drain inside the shelterbelt and be trapped there.

SOILS

The soil is a comparatively thin layer of earthy material on the land surface from which plants obtain sustenance through their root systems. It rarely extends beyond a few feet in depth, and may show great variation in nature, and in its ability to support plant growth.

The nature of the soil is largely determined by the geological material from which it was formed and the climatic conditions prevailing during the period of formation. For instance, sandy geological materials will give sandy soils, and clayey materials will

SOIL ZONES

LEGEND

1. **Brown Soils**—Short-grass prairie and western section of mixed prairie.
2. **Dark Brown Soils**—Eastern or more humid section of mixed prairie.

2a. Chiefly dark brown with some brown and some black soil.

3. **Black Soils**—Parkland prairie or aspen-grove area.
4. **Transition**—Mixed black, degraded black and grey soils, mixed with parkland-forest vegetation.
5. **Grey Wooded (Podzolic) Soils**—Forest region.

form clays. The climate affects the intensity of the weathering processes and the amount of leaching which the soil has undergone during its formation.

Climate also fixes the type of natural vegetation found in an area, and so indirectly controls the amount of humus which accumulates in the soil through the decomposition of plants. In general, the darker the soil is, the greater the amount of humus present.

SOIL ZONES

The Province of Saskatchewan is divided into four major soil zones, based on the relationship between climate and the soil. These zones are shown on the accompanying sketch map.

The Brown Soils lie in the south-western section of the Province. These soils occupy the short-grass prairie and part of the mixed prairie area. This is the driest area in the Province, and the natural grass vegetation is therefore produced less abundantly than in moister regions. The relatively lower organic matter content of the soil reflects this effect of climate on natural vegetation.

The Dark Brown Soils may be considered as transitional between the brown and black soils. The darker color of the surface soil reflects the somewhat better moisture conditions and the better growth of prairie vegetation in this zone.

The Black and Transition Soils correspond to the parkland-prairie region and here the more humid climate, and consequently the heavier growth of grass, has given rise to dark colored soils having the highest organic matter content of any in the Province.

The Grey Soils have developed under a forest vegetation. These soils are characterized by an ashy-grey layer just below the surface and are relatively low in organic matter. The main factor influencing the formation of the grey soils appears to be the effect of a long established forest cover. On the other hand, the brown, dark brown and black soils have all developed under a grass cover, and the differences between the latter zones are largely the result of the variations from semi-arid to sub-humid climatic conditions occurring in the grassland region.

It must be emphasized that soil zones are broad general separations within which there are many kinds or "types" of soils with greatly varying productiveness. Boundaries between zones are seldom distinct because of the generally gradual transition from one zone to the next.

SOIL MANAGEMENT AND SOIL CONSERVATION

The object of soil management is to maintain the soil in a fertile state while, at the same time, obtaining maximum production of the desired crops. Soil conservation has essentially the same meaning since its purpose is to conserve the soil in order to obtain the greatest possible abundance of its products now and in the future.

In a sense, the growing plant mines the soil of its nutrient elements. A thirty bushel crop of wheat requires about 50 pounds of nitrogen, 20 pounds of potassium and 10 pounds of phosphorus from the soil. Many other "plant food" elements are also required, but nitrogen, phosphorus and potassium are the ones most likely to be, or to become scarce. Most of the nitrogen, and phosphorus, is sold with the grain, but much of the potassium remains in the straw. Nitrogen and phosphorus are therefore likely to be most rapidly depleted in the soil. Fortunately, some of the soil microbes help to replenish the nitrogen supply, and a small quantity is also returned to the soil in rainfall. There are no such circumstances working towards the replacement of elements like phosphorus and potassium.

Soil erosion, whether by wind or water, is more detrimental to fertility than is depletion caused by cropping or grazing. A depleted soil can be improved by good husbandry. An eroded soil may be so far damaged that improvement or reclamation is next to impossible. Wind and water erosion remove the fertile surface layers of the land. The sifting action of the wind carries away the rich clay and humus, and leaves behind the sand. Water erosion produces similar results, and in addition, may result in the formation of uncrossable gullies.

In Saskatchewan, conservation of the soil and control of erosion have very nearly the same meaning. Erosion is a danger whenever the soil is bared to the elements, or wherever the natural vegetation is severely reduced in stand. Black cultivated fields are therefore to

be avoided, as are all cultural practices which expose the soil without sufficient protection. Sometimes the soil may be exposed through failure to control outbreaks of grasshoppers or other insects. Overgrazing of native or cultivated pastures can also reduce the vegetative cover so that the land may fall an easy prey to the ravages of wind and water.

The following sections deal with the main soil problems in Saskatchewan. Additional information regarding soils and soil problems may be found in Saskatchewan Soil Survey Report No. 12, and other Soil Survey reports, University of Saskatchewan, and from the Report of Investigations, Soil Research Laboratory, Swift Current, Sask.

MOISTURE CONSERVATION

Moisture is the first limiting factor in crop production in most of Saskatchewan. Since the average annual precipitation for the Province is only 15", reserve moisture is very important in crop production. To conserve moisture in the soil, it is necessary to prevent the growth of weeds. Even a slight infestation of weeds may seriously reduce the moisture conserved. Fall precipitation is frequently lost due to weed growth after harvest, and winter precipitation may be lost due to delay in starting fallow operations. Summer moisture may be lost by allowing volunteer grain and weeds to grow on the fallow land in the fall. Cultural operations should give complete weed control throughout the growing season, providing that control of soil drifting and control of insect pests is also accomplished. (See Section on Insect Pests, page 91.)

Snow may increase the amount of soil moisture if on melting it is able to enter the soil. Standing stubble and trash cover hold the snow on the fields and prevent run-off at the time of the spring thaw and also help to reduce loss of moisture by evaporation as they shade the ground and reduce the velocity of wind near the surface.

It would be a wise precaution if the farmer were to investigate the depth of moist soil in the spring and on that basis, to make appropriate adjustment in the amount of stubble seeded. The depth of moist soil in the field serves as a useful guide to the effectiveness of cultural practices in storing moisture and also to indicate the sufficiency of moisture reserves for the crop. For loams and clays, moist soil to a depth of two feet constitutes a fair reserve, while three feet or more is very good. A depth of 18 inches or less of moist soil indicates a low supply which must be supplemented by more than normal rainfall if an average crop is to be obtained in the drier parts of the Province.

It is better to have an inch of water stored in the soil than to depend on an inch of rain coming in the growing season and for this reason it is advisable that the depth of moisture be determined at seeding time.

Timeliness of cultivation is the essence of good summerfallow practice and the main factor in successfully conserving moisture in the summerfallow field. (See page 23.)

SOIL DRIFTING AND ITS CONTROL

Soil drifting is a serious menace to crops and soils in Saskatchewan. The danger is most serious in the spring and during seasons of low precipitation. Dry periods have occurred, and will continue to occur, so that precautions against damage from soil drifting are required even when moisture conditions appear to be favorable.

The methods of soil drifting control outlined below are designed to accomplish one or more of the following objectives:

1. The reduction of wind velocity over the surface of the soil.
2. The establishment of a cover to prevent the soil being exposed to the wind.
3. Increasing the size and stability of granules and clods.
4. The trapping of moving soil particles.

These results can be accomplished most effectively by proper tillage methods.

Tillage Methods

The prevention of soil drifting by tillage is dependent upon the maintenance of a good trash cover or a cloddy condition of the soil, or both. Tillage operations, therefore, should give effective weed control and also leave the

land in a condition resistant to soil drifting. STUBBLE SHOULD NOT BE BURNED.

The kind and amount of tillage required in any one year is influenced by the amount of stubble present, the amount of weed growth during the season, and the moisture content of the soil. Since each of these factors may vary widely from season to season, it is impossible to follow any standard cultural practice. Where there is a heavy combine stubble it is relatively easy to maintain a good trash cover. With a light stubble, precaution must be taken to keep all the stubble anchored at the surface of the soil, and, for this purpose, implements such as the duck-foot cultivator, rod-weeder and blade-weeder are quite effective.

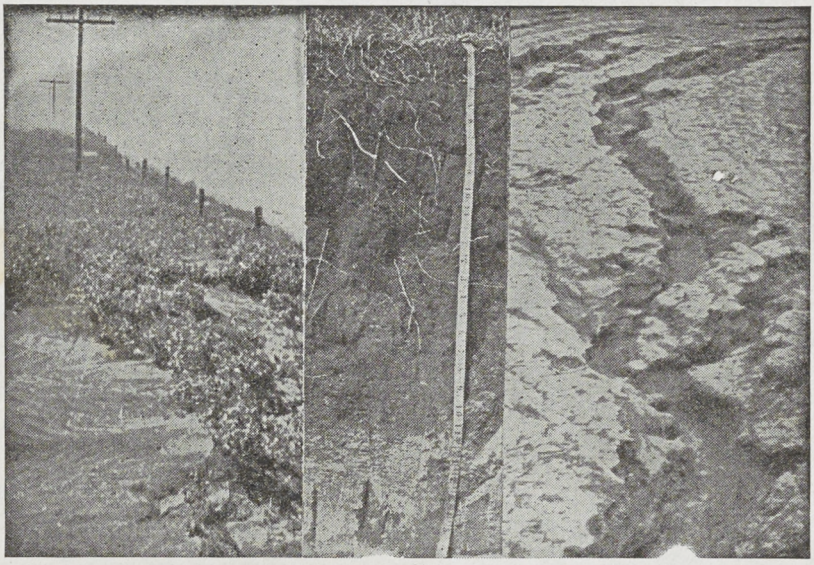
If there is very little stubble the only trash available will be from the weeds. Experience has shown that weeds make a very poor trash cover because they decay at the surface of the ground and blow away. The result is that what looked like a good trash cover just after working, frequently is a badly drifted field the following spring.

On some soils the plow can be used in working fallow land when there is not sufficient stubble to form a trash cover. This is particularly true on loam soils. When a fallow is plowed the stubble is buried and clods and ridges are depended upon to prevent drifting. Late plowing (during July) is preferred to early plowing, because less subsequent tillage is required to control weeds, thus leaving the soil in a more cloddy condition. It is important, however, that weed growth be kept in check by cultivation during the early part of the season to conserve moisture and to have the land in a moist condition for plowing. The least possible amount of tillage should be given after plowing in order to preserve a cloddy surface.

Some form of tillage previous to seeding is generally required in the spring. The disc type implements are usually more effective in creating a lumpy surface under fairly moist conditions and particularly on the heavier soils. The duck-foot cultivator or spring-tooth cultivator is more effective when the soil is not too sticky.

The latter implements are suitable for creating a ridged, lumpy condition on loam soils.

The one-way disc with seeder attach-



Centre—Profile of virgin black loam soil. This soil is naturally deep and fertile, and can be maintained in a fertile state if carefully managed under cultivation.

Left—Destructive wind erosion in action. The field in the background of this picture is suffering permanent damage because of loss of clay and organic matter.

Right—Water erosion is permanently damaging this field. These gullies are small at present, but they enlarge to become serious barriers to cultivation. Already, much fertile top soil has been swept from the field.

ment is a satisfactory machine for working and seeding the land. This is especially true when there is a heavy trash cover. (See section on Farm Machinery, page 25.)

Strip Cropping

Strip cropping is a useful practice in combatting soil drifting and is often used in areas of southwestern Saskatchewan. The method is most applicable on medium textured soils such as loams and clay loams.

Under ordinary circumstances, strips may be as much as forty rods wide. However, when the stubble is thin it is advisable to use much narrower strips. Strips may be reduced to half their width by seeding a narrow strip of oats down the centre of each. This gives, in effect, two 20-rod strips in place of one of 40 rods width. When better crops are harvested, the strips may again be widened to 40 rods.

The width or position of strips in a field may be changed by seeding the whole field one year and laying out the new strip crop arrangement the following season. If the field was in wheat the previous season and if sawfly is a problem in the district, a sawfly-resistant crop should be used when seeding the field solidly. (See section on Insect Pests, page 96.)

Sandy Soils

Sandy soils are extremely subject to drifting because they do not form resistant clods.

Suggested cropping practices for this type of land in the drier areas are:

1. Seeding down permanently to grass or a grass-legume mixture for hay or pasture.
2. Continuous cropping to wheat, oats, barley or rye. A long stubble is left when harvesting, to collect snow.

In the moister areas of the Province, as in the black and grey soil zones, a rotation including grass, legumes or a grass-legume mixture will give more satisfactory control of erosion on sandy lands. Seeding down for a few years, followed by breaking and a limited number of grain crops, gives a more flexible arrangement of this rotation.

In continuous cropping, or in cover cropping care must be taken against the destruction of the cover by grasshoppers (See Section on Insect Pests, page 94.)

Sandy soils are liable to erosion whenever the surface is unprotected. Therefore, cultural practices should be planned so that there is the least possible exposure of bare, unprotected soil. Any cover, even weeds, is better than no cover on these soils. It is recommended that sandy soils be worked only when moist, and packed immediately.

Emergency Methods

Emergency methods are employed to deal with two specific conditions of soil drifting:

1. The commencement of soil drifting on one or more isolated spots in a field that otherwise has not suffered from drifting.
2. Widespread drifting over whole fields or larger areas, due to lack of stubble and trash.

In the first case, soil drifting begins in a relatively small part of a field. If unchecked, it extends rapidly and may quickly involve several fields if effective preventive measures are not promptly taken. The effectiveness of emergency measures depends largely on alertness and energy in putting such measures into operation **immediately** there are indications of the beginning of drifting. It should be further pointed out that delay endangers neighboring farms and so the community as well as the individual suffers.

Emergency measures which may be used effectively to prevent the spreading of such spots are:

A. Plowing furrows at intervals of a few feet or yards around and throughout the area.

B. Deeply ridging with an implement such as a duck-foot cultivator, with half the shovels removed, or equipped with listing shovels.

C. Spreading manure or straw over the areas that are likely to drift, preferably before drifting starts.

D. In plowed fallow a hay rake has been used to bring clods to the surface.

Any portions of a field which are a continual menace should be seeded permanently to grass.

Where large areas are drifting it may be necessary to adopt some system of strip cultivation to gain control, after which the area can be farmed by the most applicable of the methods previously described.

On lighter soils where the surface has been removed by wind erosion, further drifting can be checked by discing the entire area when the soil is wet, and then seeding immediately. Following this treatment, however, the field should be watched closely and

furrows plowed at once should any part of the area show signs of starting to drift.

Cover Crops

Cover crops are used to control drifting on summerfallow land but have limited application. The cover crop is usually sown about the first of August. The object is to obtain a moderate growth to serve as protection against drifting during the following winter and spring, without using too much of the moisture stored in the summerfallow. The rates of seeding are usually ½ bushel of wheat, or ¾ bushel of oats or barley per acre. It is advisable to use a similar crop to that which is to be grown the following year. This method may be successful where moisture conditions are favorable for establishing a stand, and in the absence of grasshopper infestation.

WATER EROSION AND ITS CONTROL

In recent years there has been a notable increase in damage by water erosion in Saskatchewan. In certain areas this is now the most important soil problem.

Almost any type of soil may be affected and as a general rule, whenever water is allowed to flow freely over bare soil, erosion damage will result. The faster the water flows, and the greater the volume, the more serious the damage. Heavy rains or quick thaws may occur in any part of Saskatchewan, and bare, unprotected fields are likely to suffer from erosion as a result.

Conditions which tend to increase the effect of water erosion are: (1) poor structure; soils which have a good cloddy granular structure (commonly spoken of as good tilth) absorb water most readily so that less remains to run over the surface. Maintaining the organic matter content of the soil by returning all straw and trash, by manuring, or by a suitable rotation, are practices which will help to ensure good tilth. (2) Lack of surface cover. The less stubble and trash, or the thinner the crop, the more damage can occur to the soil from the impact of rain drops, or from running water. (3) The slope of the land. Erosion damage tends to increase with steepness of slope and with length of slope. Both the rate and volume of flow increase as the steepness and length of the slope increase—and so erosion damage is greater. (4) Implement marks and direction of cultivation. Marks left by implements working up and down the slope seriously increase the hazards of erosion because such marks may provide an easy channel for running water to follow.

Heavy soils are generally more likely to suffer than light soils, because heavy soils absorb rainfall less rapidly. The nature of the subsoil may affect the rate of damage and also the degree of damage to a field. Soils with tight subsoils generally erode faster than those with absorptive subsoils. Land with a stony subsoil is less easily reclaimed after erosion damage than is land free of stones. Exposed subsoils are generally much less fertile than the original surface soil and in some cases may be so low in productivity that it is no longer worth while retaining the land under cultivation. In cases where uncrossable gullies form, there is the added cost of cultivation due to smaller and irregular shaped fields.

Damage from water erosion may occur in three fairly distinct ways. These are sheet erosion, rill erosion, and gullying.

Sheet erosion is a more or less uniform removal of the top soil. It commonly occurs on the tops of knolls and on the upper areas of slopes. This type of erosion is least likely to be noticed, but it seriously affects the productivity of the soil.

Rill Erosion is the formation of miniature gullies. This type of erosion generally occurs on the steeper slopes. While the removal of surface soil is less uniform by rill erosion than by sheet erosion, nevertheless the loss of surface soil may eventually be as great. On the longer slopes rills tend to converge into one channel and form gullies.

Gullies are erosion channels of such width and depth that they interfere with the cultivation of the land. The channels are generally deep enough to penetrate beyond the cultivated layer and into the sub-soil. The formation of gullies may be the first observed sign of water erosion, but usually much damage from sheet and rill erosion precedes gullying. However, the larger rills and shallow gullies of today, if unchecked, may in a few years attain such size that they cannot be crossed with farm implements.

Methods of Control

The control of water erosion in many respects is similar to the control of wind erosion, and some of the methods

used may be effective for both conditions. Measures for controlling water erosion depend upon increasing the absorption of snow and rain water by the soil. Water in excess of the soils absorptive capacity must be directed down the slopes in such a manner that it does not carry soil with it. Methods that may be used to accomplish such ends are as follows:

1. Use tillage practices which keep the stubble and trash anchored at the surface of the soil. This not only retards the flow of water but leaves the land in a condition to absorb it. Stubble should not be burned. In areas where excessive cultivation of the fallow is required to control weeds, it is difficult to maintain an effective trash cover. The use of grass and legumes in the rotation will increase the organic matter content of the soil and thus minimize the damage from water erosion.

2. Where practical, contour strip-cropping may be used to good advantage. In any case cultivation should be across the slope of the land, and as nearly on the contour as possible.

3. Steeper slopes should be seeded to hay or pasture crops, especially where such slopes deliver run-off water to lower arable fields. Exceptionally steep slopes should be kept permanently under grass.

4. Gully control may be accomplished in the following ways:

(a) By control of run-off from upper slopes as outlined above.

(b) By diverting the flow of water before it reaches the gully by constructing a diversion channel of sufficient size to accommodate the run-off. This channel must be seeded down and it may be necessary to clear it of snow in the spring. The possibility that road ditches or culverts are contributing to gully erosion by concentrating run-off water should be examined. In such cases appropriate steps should be taken to direct the flow into protected channels.

(c) By seeding the gully permanently to a grass suitable to the locality. The sides of the gully should be sloped gently before permanent seeding is undertaken. It is advisable to grow an annual crop and seed the grass into the stubble so as to protect the grass in the seedling stage, as well as to protect the channel temporarily. The grass should be seeded well up the sides and slopes of the gully channel. Care to avoid destroying the grass by cultivation or over-grazing is essential.

(d) In severe cases when the gully is so deep that smoothing the slopes becomes difficult, it may be necessary to construct low dams at frequent intervals in the channel. Such dams may be constructed of poles and brush, rocks, straw and brush fastened by wire, or other cheap materials, and need not be watertight. The dams check the rate of flow, and the silt deposits gradually fill the gully. Revegetation of the channel, either by native or cultivated plants, should be promoted in every way possible. Manure or straw spread in the bottom of a gully will give some temporary protection while reclamation is underway.

FERTILIZERS AND SOIL PRODUCTIVITY

The aim in maintaining or in building up soil fertility is to have a satisfactory supply of all plant nutrients available in the soil. The need for maintaining soil fertility may be more fully appreciated if the relationship between plant growth and plant nutrients is known. If one or more of the plant nutrients is not available in adequate amounts then yields will be lowered even though all other conditions affecting plant growth may be entirely satisfactory. The deficiency of a plant nutrient in a soil may be made up by applying farm manure, by using commercial fertilizers and by certain crop rotations. These items are discussed in the following paragraphs.*

Farm Manure

There are many soils on which manure can be used to good advantage, such as the grey wooded, peaty, sandy and alkali types, as well as on older fields. Better responses follow the use of manure throughout the park belt and wooded zones than on the plains.

Little apparent benefit may result from the use of manure on the more fertile soils.

Light rather than heavy applications of manure are advisable, 10 to 12 tons per acre being quite sufficient. This allows a greater area to be covered by the limited amount of manure available, and prevents excessive drying out

*More detailed information on the use of fertilizers may be found in "Fertilizers in Saskatchewan" Bulletin 122, University of Saskatchewan, Saskatoon.

of the soil. The limited supply of farm manure available should be applied where greatest benefits will result. On light colored knolls manure will help to reduce erosion, will increase yield, and give better uniformity of the crop. The so-called "bluff Podzol" spots (grey areas) frequently found in small depressions in the black and transition soil zones are improved in structure and fertility by applications of manure. Pastures are usually benefitted by light applications. Alfalfa fields also respond, especially on grey wooded soils. It is best to apply the manure during the fallow year, or as far in advance of planting time as possible. For gardens, light applications of manure are generally beneficial, but over-manuring should be avoided.

Farm manure, while a very valuable fertilizer, is not in itself ideal since a ton of farm manure contains approximately only five lbs. of phosphate, 10 lbs. of nitrogen and 10 lbs. of potash. Phosphate is the element most frequently lacking in Saskatchewan soils, thus the nutrient most needed is present in the smallest amount in manure. By adding commercial phosphate fertilizer to manure, or by applying it to manured fields, better returns may be obtained.

To obtain the proper decomposition of stored manure keep the pile well packed and moist. The pile should be on level ground, rather than on a slope, and the top of the pile should be fairly flat. It should be noted that it is only in heated manure that weed seeds are destroyed.

Commercial Fertilizers

The sale of all fertilizer materials is regulated by the Plant Products Division of the Dominion Department of Agriculture, under the authority of the Fertilizer Act. The analysis of the fertilizer must be indicated on the bag or package, and is guaranteed by the company manufacturing it.

The elements nitrogen, phosphorus and potassium are of great importance to plant growth. Commercial fertilizers may carry one, combinations of two, or all three of the above elements. If all three are present the material is called a complete fertilizer.

A short method of indicating the percentage of each element in complete fertilizers, and also in fertilizers containing only two of the three elements, is in common use. For example a 4-8-10 fertilizer contains 4% nitrogen, 8% phosphate (expressed as phosphoric acid anhydride) and 10% potash (expressed as potassium oxide). The order of expressing such analyses is always as given above; that is, nitrogen, phosphate and potash.

Nitrogen in fertilizers may be in the form of ammonium sulphate, various nitrates, nitrogen in combination with phosphorus as ammonium phosphates, or in organic forms such as blood meal. Phosphorus is in the form of phosphate, although reported as phosphoric acid anhydride. It is commonly sold as super phosphates or ammonium phosphates. Potash is in the form of sulphates and chlorides (muriates) of potassium.

In addition to nitrogen, phosphorus and potassium, fertilizers may contain other elements of value which are not indicated in the analysis. The element sulphur is an example. Sulphur is of value as a fertilizer for the northern grey wooded soils, especially where legumes are being grown.

The prices of fertilizers, everything considered, should bear some comparison with their plant nutrient content, hence in purchasing a fertilizer it is important that the analysis printed on the bags or packages be examined.

Effect of Fertilizers

Experimental work of the last ten years and more has indicated a favorable response to phosphatic fertilizers on summerfallow in all except the brown soil zone. The average increase in the black soil zone is about six bushels per acre for wheat on summerfallow while in the dark brown zone, an average increase of four to five bushels per acre would be a fair estimate. The grey wooded soils show responses to phosphate fertilizers, but these soils respond best to good rotations along with the use of proper fertilizers. Legumes on such soils show a greater response to sulphur carried by the fertilizer than to any other element.

Where responses are obtained, phosphate fertilizers increase root development, growth and stooling. The fertilized crop generally matures earlier and stands are more even. As a result there is less risk of damage from frost, rust and insects, other than sawfly. Damage from rootrots is reduced, particularly browning rootrot which is well controlled where phosphates are applied. The fertilized crop competes more successfully against weeds.

Where crops tend to be rank, green and late, as sometimes occurs on rich black soils or on heavily manured lands, phosphates often give marked effects in hastening maturity and strengthening the straw.

While yield and quality must finally be the deciding factors as to the possible economic use of fertilizers, consideration of all these various effects are helpful in deciding upon the advisability of their use.

Residual effects are seldom obtained on grains in the ordinary fallow-grain rotation. Residual effects on a grain crop following a fertilized crop of alfalfa may be very pronounced especially on grey wooded soils.

As a general statement, phosphatic fertilizers give best results in cool, moist seasons, and in the moister areas of the Province. Heavy soils give better responses than light-textured soils, especially in drier areas. On the same land, quite large differences in response may be observed in different seasons.

There is little evidence of a need for nitrogen for brown, dark brown or black soils. However, 11-48-0 Ammonium Phosphate which contains 11% nitrogen and 48% phosphate seems to be the best carrier of phosphate for such soils. The better results obtained may not be due to the added nitrogen, but rather to the greater efficiency of this compound as a carrier of phosphorus.

There appears to be a definite need for nitrogen on grey wooded soils and on some sandy soils. The need for nitrogen in such cases is best taken care of by the use of properly inoculated legumes in a rotation and by the application of manure.

The element potassium appears to be in good supply in Saskatchewan soils. Tests made so far show little evidence of a need for this element. As already noted, sulphur is commonly deficient in grey wooded soils for the growth of legumes.

Acid (sour) soils seldom occur in the Province and the use of lime is therefore rarely advisable.

It is not unusual to hear the opinion expressed that fertilizers impoverish or have other detrimental effects on the soil. There is no basis for such fears with the fertilizers commonly used in this Province.

Fertilizer Recommendations

Further experimental work is required to give information regarding the use of fertilizers for all the diverse soil and climatic conditions of Saskatchewan. However, the work done up to the present gives a basis for the general recommendations to follow.

Brown Soil Zone.—Although the use of commercial fertilizers is not generally recommended for the brown soils, some response to phosphates has been obtained in favorable seasons. The heavier soils are more likely to respond than are the lighter soils. When fertilizer is used in this area, the lower rates recommended for the dark brown soils are applicable.

Effect of phosphatic fertilizer on wheat grown on black soil. The fertilized crop (right) is taller, more mature and less weedy than the check plot.

Dark Brown Soil Zone.—The use of phosphatic fertilizer on summerfallow crop is generally beneficial in this zone. The fertilizer recommended is 11-48-0 Ammonium Phosphate at from 30-50 pounds per acre. The lower rates of application are advisable on light textured soils, and under less favorable moisture conditions. The higher rates are desirable on heavy soils and with good moisture reserves.

Black Soil Zone.—In the black soil zone (park belt) increased yields from the use of phosphatic fertilizer are quite consistently obtained. In the more moist areas of this zone, particularly adjacent to the grey wooded soils, stubble crops may respond. However, the better increases are obtained on summerfallow land. The use of 11-48-0 Ammonium Phosphate at 40-60 pounds per acre is recommended for the black soils. As in the case of the dark brown soils, the lower rates are advisable on lighter soils and where moisture reserves are less favorable. On stubble crops, slightly lower rates are recommended.

Recommendations for **degraded black (transitional) soils** are the same as given above for black soils. On light textured soils of this zone, especially where erosion has resulted in some depletion of nitrogen and organic

matter, 16-20-0 Ammonium Phosphate may prove the best fertilizer. The latter fertilizer supplies more nitrogen than 11-48-0. However, the proper and best means of replacing nitrogen and organic matter in such soils is through the use of suitable crop rotations.

Grey Wooded Soil Zone.—Grey wooded soils tend to be deficient in organic matter, nitrogen, phosphorus and sulphur. They may produce fairly good crops of grain for a few years, but the yields generally fall off quickly under straight grain production.

The best cropping system on such soils is one which supplies organic matter and nitrogen. Therefore, rotations which include inoculated legumes are highly desirable. In addition, all available farmyard manure should be applied to the land.

Legumes may be fertilized with the following sulphur carrying fertilizers: single superphosphate, 2-20-0 Ammoniated Phosphate: 16-20-0 Ammonium Phosphate, or land plaster (gypsum). These should be applied broadcast or by drilling at not less than 50 pounds per acre and preferably in the fall. Probably the most desirable of the above fertilizers is either 2-20-0 or 16-20-0, both of which carry sufficient sulphur. They have equal amounts of phosphorus (20%) but differ in the amount of nitrogen (2% and 16%). On account of its higher nitrogen content, the 16-20-0 may be less desirable where legumes are harvested for seed, although experiments so far conducted have not indicated any clear difference in results. Legumes on light textured, grey wooded soils are most likely to need fertilizing but heavier soils have also shown good increases.

In fertilizing grains on grey wooded soils, either 11-48-0 or 16-20-0 may be used. The 11-48-0 should be applied at 40-60 pounds per acre, and the 16-20-0 at 50-75 pounds per acre. The latter fertilizer is the more desirable where no provision has been made for adding organic matter and nitrogen through a good rotation, or by manuring.

The best cropping system for the grey wooded soils is some kind of rotation which includes a legume, or possibly a mixture of legume and a grass. In fertilizing such a rotation, a suggested procedure is to fertilize the first grain crop after partial fallow with 11-48-0, and to fertilize the nurse crop for the legume with a fairly heavy application of 16-20-0. The latter carries sufficient sulphur so that an application of about 75 pounds per acre will supply the legume for at least two seasons. In this way, the necessity of fertilizing the legume crop might be eliminated.

Leave a check strip.—In all cases where fertilizer is used, it is advisable that an unfertilized check strip be left in the field. By the use of such a check, one can observe effects on growth throughout the season, and estimate the advantages obtained from the use of the fertilizer.

Application of Fertilizers

For best results, fertilizers should be applied with a proper fertilizer attachment on the grain drill or one-way. This places the fertilizer in the drill row with the seed, thus enabling the roots of the developing plant to come quickly in contact with it, and thus make the best possible use of the material. Attachments are relatively inexpensive, are easily adjusted, are light and do not injure the drill or interfere with its operation. They may be obtained through local fertilizer dealers.

A Cyclone seeder is convenient for broadcasting fertilizer on established stands of legumes.

Fertilizer should not be applied by mixing it in the seed box with the grain. This will injure the drill and uneven rates of seeding and fertilization are also likely to result.

For further information regarding the use of fertilizers, contact your Dominion Experimental Station, your Agricultural Representative, or the University of Saskatchewan, Saskatoon.

SPECIAL SOIL PROBLEMS

Soil Alkali.—Alkali or salinity, while of widespread occurence, is not one of the major soil problems for Saskatchewan as a whole, but it is very important on some farms. It is one of the major problems in irrigation farming. The term "alkali" refers to the presence of various soluble salts in the soil. In Saskatchewan, these salts are chiefly sulphates, although sometimes chlorides are present. Sodium sulphate (Glauber's salts), magnesium sulphate (Epsom Salts) and calcium sulphate (gypsum or land plaster) constitute the bulk of the alkali salts. The chloride salts are usually more injurious to plants than are the sulphates.

The general appearance of the soil

is a guide to the presence or absence of alkali salts, for such soils have no pronounced structure. When dry, they are usually greyish in color and greyish-white specks may be observed in the lower surface soil. Distinct concentrations of salt crystals are often found at a depth of 6" to 10". Where the concentration of salts is high, some bare patches of soil occur. These patches have a white incrustation of salts in dry weather and represent the so-called "white alkali" land which is usually found in low, poorly drained areas subject to flooding. Where less salts are present, there may be few or no bare patches, but the natural vegetation will be made up of plant species tolerant of alkali. To determine the amount and kinds of salts present in an alkali soil, it is necessary to obtain an analysis of the soil.

The only practical treatments which can commonly be applied are: improvement of drainage, application of farm or green manures, and the use of alkali-tolerant crops. There is no chemical treatment which will improve "white alkali" soil.

Black Alkali, which is due to sodium carbonate, is much less common in Saskatchewan than is white alkali.

Plants differ greatly in their tolerance to alkali. Below are listed common forage and cereal crops in the order of their tolerance to salts.

A. Seed Crops.
   1. Rape, barley, rye and oats—fairly tolerant.
   2. Wheat—slightly tolerant.
   3. Flax—not tolerant.

B. Forage Crops.
   1. Sweet Clover—very good, may eventually reduce alkali content somewhat.
   2. Alfalfa—good, once it is established.
   3. Slender Wheat Grass (Western Rye Grass)—Good.
   4. Brome and Crested Wheat Grass—moderate.
   5. Reed Canary Grass—slight.
   6. Red Top and Timothy—not tolerant.

See section on forage crops for suitable mixtures for alkali areas.

C. Among garden plants, beets and mangels have high tolerance, potatoes moderate and corn slight tolerance. Small fruits and tree fruits are generally sensitive to salts, some of them extremely so. Alkali land should be carefully avoided as a site for a garden.

Light Colored Eroded Soils.—Light colored knolls, or eroded areas frequently observed in cultivated fields are a result of the removal of the thin surface soil, and exposure of the light colored limy subsoil. Such soils are often droughty and low in productivity, and contribute to a lack of uniformity in maturity of crops as well as in stand.

In improving these soils, it is most important that steps be taken to build up their organic matter content. This may be accomplished by manuring, or by turning under green manure crops. All available crop residues should be worked into the soil surface. The productivity of the soil will usually be improved by the use of phosphatic fertilizer. Wind and water erosion must be prevented, and all tillage operations, and cropping practices adopted, should have this end in view.

Sometimes the improvement of these eroded areas cannot be achieved while the field is being cultivated due to the continuation of erosion. In such cases, it is advisable to seed the land either temporarily, or permanently to grass.

"Bluff Podsols."—In the park belt, the low spots frequently have grey, almost white soils which have a soft unstable structure, and produce poor unthrifty crops. Their productivity can be very much improved by adding organic matter in the form of farm manure, by turning down legume crops such as sweet clover and by using fertilizer for cereals. These soils contain no alkali and can be brought to a reasonably satisfactory state by improving their organic matter content.

Peat.—Peat should never be burned, since the organic matter contained in peat is extremely important for its successful cultivation. Peaty areas usually require improved drainage. If by deep plowing, mineral soil can be mixed with the peat, such soils can be brought immediately into production, most profitably with coarse grains since the crop tends to be late. Deeper peat is best handled by pasturing for some years. The animals pack and manure the peat and so hasten decomposition. Peat soils respond very well to fertilizers, especially 16-20-0 ammonium phosphate. Burned-over peats require the addition of organic matter such as manure or turned-down clover crops, as well as commercial fertilizers. They are generally not so satisfactory as soils which have not been burned.

"Burnout" or "Blowout" Soils.*—These soils occur in several large areas on the prairies and in small areas, even into the margin of the forest. They are characterized by an uneven pitted surface and an extremely heavy, impermeable sub-surface layer. The pits, or depressions were formed as a result of erosion some centuries ago. The depressions, which are roughly circular in outline, are from a few feet, to many feet in diameter and from six to twelve inches deep. Where the depressions occur, the surface soil has usually been completely removed and the hard subsoil is exposed. It is this fact which is largely responsible for the difficulty found in successfully cultivating such soils. Every effort should be made to add organic matter to the burnout lands, through returning all trash and stubble, and by manuring, or growing sweet clover wherever practicable. The one-way disc appears to be a suitable implement for cultivation, and it should be used when the soil is moist, and therefore more likely to work into a friable state.

These soils tend to improve under cultivation. There are two reasons for such improvement. First, there may be an increase in organic matter and improvement in tilth. Secondly, the surface soil is spread over the depressions by cultivation and so the subsoil layer is at least partly covered. Power equipment and careful management are two important factors in farming the "burnout" soils, and seem to be almost essential to success.

*Described fully under Echo and Trossachs Associations, Soil Survey Report No. 12, University of Saskatchewan.

SOIL TESTS

Where some particular soil problem is present, it may be desirable to have the soil tested. The following cases are examples where useful knowledge may be obtained from a soil test:

1. Presence of alkali is suspected (small irrigation project).
2. The soil is thought to be acid (sour).
3. Presence of an unproductive area in a field that is otherwise productive.
4. A field of distinctly low productivity.
5. Peculiarities of plant growth on an area.

Little is to be gained from a soil test if there is no specific soil problem.

DIRECTIONS FOR SAMPLING SOIL FOR A SOIL TEST

The selection of a soil sample for examination requires considerable care in order that it may be representative of the area in question. Distinctly different types of soil should be sampled separately, never bulked in the same sample.

The Surface Sample.—A spade or trowel is a suitable implement to use in obtaining the samples. Select a uniform area and take 6 to 10 samples obtaining a uniform slice of soil to a depth of 6". Place the samples in a clean pail or other container, mix thoroughly, and forward about 1 lb. of the soil from this mixture.

The Sub-Soil Sample.—In order that the best information may be obtained, a sample of the sub-soil should also be forwarded. Select a representative point in the area and obtain a sample of about 1 lb. weight at a depth of 12" to 18". In addition the presence of gravelly layers or any unusual condition of the lower sub-soil should be mentioned.

Labelling.—Samples should be clearly labelled with the name and address of the sender on the outside of the container. Also state whether the sample is from the surface or the sub-soil. If more than one sample is forwarded, they should be labelled in such a way that each one may be referred to separately.

Containers.—Samples must be forwarded in clean containers such as cans, paper bags or cardboard boxes. Never use containers which have held table salt, Epsom salts, baking soda, washing soda, etc.

The following information should be provided:

Location.....¼ of Sec.....Tp.....Rge.....
How long has the land been under cultivation? .....
What crops have been grown?.....
Have any peculiarities been noted in the growth of crops?.....
What weeds are most troublesome on the land? .....
If the land is uncultivated, describe the natural vegetation in a general way.....
Describe the topography (level, undulating, rolling) .....
Is the area low or subject to flooding?.....
General remarks, including reasons for requesting analysis.....

Soil samples to be tested should be sent to the Soils Department, University of Saskatchewan, Saskatoon. There is no charge for this service.

Cropping Systems and Cultural Methods

CROPPING SYSTEMS

The cropping practices followed in the various soil zones have developed as a result of such factors as climatic conditions, particularly the amount and distribution of rainfall and the evaporation in the area, the type of soil and topography of the land, size of farm, access to grazing lands, markets available and the aptitude of the farmer himself.

The two chief objectives in planning a cropping system are profitable production of the crops adapted to the area and the maintaining of the fertility and physical condition of the soil. The maintenance of all stubble and trash at the surface of the soil will not only assist in preventing soil erosion but will do much towards keeping up the amount of organic matter in the soil and thereby assist in maintaining the fertility.

Since conditions vary considerably from one soil-climatic zone to another, it is necessary to consider the region concerned when planning suitable cropping systems.

The control of insects should be given consideration in any cropping plan and adjustments made as necessary to reduce crop damage. This may involve a temporary change in the crop rotation, choice of crops, date of seeding or time and methods of cultivation. It sometimes happens that emergency methods of control may differ from what is ordinarily considered good farming practice. Under these conditions the most desirable procedure for the district should be followed. (See section on Insect Pests, page 91.)

When necessary, provision must also be made in the cropping plans for the control of plant diseases. This may include such practices as treatment of seed with a mercuric dust, the use of phosphatic fertilizers and early seeding at moderate depths. (See Plant Disease Section, page 81.)

A cropping system to give best results should be flexible enough to allow for adjustments when changed conditions warrant it. For example, in a season when soil moisture conditions are particularly favorable in the spring, some extra stubble land could be sown to take advantage of this situation. (See Soils Section, page 9.)

THE BROWN SOIL ZONE

Soil moisture is the chief limiting factor in crop production in this zone and frequent use of the fallow for conserving moisture is essential. Stubble land should be seeded only in years when there is a good supply of reserve moisture in the soil. The principal system of cropping is alternate grain and fallow with wheat as the main cash crop. Experimental results over a period of years indicate that oats and barley sown early on fallow will outyield wheat in pounds per acre. Because of this fact the acreage seeded to barley, and to a certain extent to oats also, is increasing steadily.

Flax is a more uncertain crop due to its inability to compete with weeds, especially Russian Thistles, but it can be grown fairly successfully on the heavier soils. Grasses and legumes can be used to advantage for hay or pasture. However, they should not be included in any systematic rotation because of the uncertainty and time required to establish stands.

Although this zone is outside the area where winter wheat has been established as a dependable crop, the crop has been grown with a fair degree of success, especially in the southwestern corner of the province. Much experience is still necessary, however, to determine the value of winter wheat as a permanent crop in this area.

THE DARK BROWN SOIL ZONE

Here also, moisture is the chief limiting factor in crop production and the same general principles apply. This region is also most suitable for grain production and frequent use of the fallow is necessary for moisture conservation. Over much of this region the three-year rotation of fallow-grain-grain is commonly used with good results. In parts of the area bordering the brown soil zone, where moisture conditions are less favorable, the two-

year rotation of fallow-grain is often used. Wheat is the main crop but coarse grains are grown to a greater extent than in the brown soil zone.

Experiments have indicated an advantage in a rotation where wheat is followed by oats or barley rather than by a second crop of wheat. This principle can be adopted in this zone as it is not so necessary to seed all coarse grains on fallow as it is in the brown soil zone. In most parts of the dark brown soil zone, however, it is good policy to seed at least part of the coarse grains on fallow, particularly oats. Early seeding of these crops is advisable. Flax can be produced in this region with good results providing that weeds are controlled. Stubble land will usually produce a satisfactory crop unless the season is very dry.

As coarse grains do well and grass and legume crops are well suited to this area, mixed farming can be practised and more livestock maintained than in the brown soil zone. While the area sown to grasses and legumes is comparatively small, these crops can be used to good advantage for soil improvement and to help in the control of soil drifting. Crested wheat grass, brome and alfalfa are suitable forage crops for this region.

Since the combine harvester is in general use over this area, all the straw is left on the land and can be kept anchored at the surface by proper tillage practices.

When it is necessary to use grass and legume crops for soil improvement, one or more fields as required can be seeded down for pasture or hay and left a few years or until a good sod is formed, then broken up and other land seeded down. Phosphatic fertilizers have usually increased yields of grain crops.

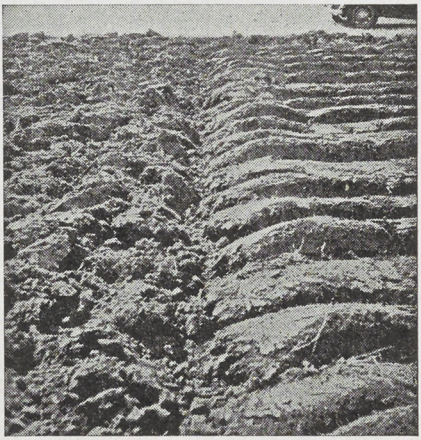
THE BLACK SOIL ZONE

This region is well adapted to grain production and yields are usually high. Recommended varieties of wheat, flax, oats and barley are suitable crops and the quality is usually good. The fallow is used in the cropping system but less frequently than in the brown soil regions. Weeds are a serious problem throughout this zone, particularly in the eastern part where perennials, such as Sow Thistle and Canada Thistle, as well as the annuals, especially Wild Oats, are troublesome. For this reason, the fallow is used considerably for weed control. A rotation of fallow-grain-grain is being used with good results in a large part of this zone.

Some modifications of the regular fallow are practised occasionally in the eastern part of this zone. This may consist of a partial fallow early in the season for control of annual weeds. Then early maturing barley or oats are sown and harvested for grain or hay.

This region is favorable for the growth of grass and legume crops. These, along with the coarse grains, can be used profitably in the production of livestock and livestock products. The grass and legume crops are useful in weed control and help in soil improvement. Soil drifting is usually not as serious as in the other two zones, though it can become a serious problem. The grass and legume crops are effective in the control of both soil drifting and water erosion. Brome grass and alfalfa do well in this region and make a suitable mixture for hay or pasture.

Pasture or hay fields in parts of this zone can be prepared for partial fallow after the hay crop is removed or the land has been pastured during the early part of the season. The land can then be worked for the remainder of the season and sown to a grain crop the following spring. In the drier parts of this zone it is worth while to plow the grass land early in June and fallow for the remainder of the summer in order to conserve moisture for the following year's crop.



Newly broken sod of Crested Wheat Grass (right). Sown 1935, plowed 1939. An excellent illustration of its value in the rotation in restoring fibre to the soil. Compare with land plowed at the same time (left) which lacks the root fibre.

When using these crops in a rotation with grain, it is not necessary to follow a definite rotation, although this can be done in this region if desired. A start can be made by seeding down one or more fields for hay and pasture, leaving them down for a few years, then breaking up and sowing to grain again. There is some advantage in this system, for in this way the field can be broken up any year that is considered suitable, making the rotation quite flexible. In this region the grass and legume can be sown with the grain on fallow and as a rule a good catch is obtained.

The use of phosphatic fertilizers gives good results in most of the black soil zone, usually resulting in increased yields of grain on fallow.

THE GREY WOODED SOIL ZONE

In this region straight grain growing cannot be carried on successfully as yields fall off quickly under this system. In order to obtain satisfactory results it is necessary to use a cropping system in which legumes and grasses are included and provision should also be made for the application of commercial fertilizers. The fertilizer should be sown with the grain crop in the rotation. (See Soils Section, page 15.) On some soils it should be used with the crop on stubble land as well as on fallow or breaking. Alfalfa is the legume usually grown. Unless it is being produced for seed it should be sown in a mixture with a grass crop.

As moisture conditions are usually quite favorable in this zone it is not necessary to use the fallow in a crop rotation for moisture conservation but it may be required under certain conditions to assist in the control of perennial weeds. If perennial weeds can be controlled by forage crop production, experience has shown that higher profits result from grain-forage crop rotations without a complete fallow. If it is necessary to fallow oftener than once in three years, a rotation containing legumes should be adopted immediately to give higher profits per acre. For this soil zone, coarse grain crops are more suitable than wheat and a system of mixed farming is well adapted to the region. It is particularly important to follow a rotation that includes legumes and grasses as well as grains. Barnyard manure is of special value in this type of soil.

FALLOWING METHODS

The management of the fallow is a very important factor in successful crop production. The main principles of fallowing are:

1. Conservation of the maximum amount of soil moisture.
2. Maintenance of trash cover or a lumpy condition of the soil to prevent soil drifting.
3. Control of weeds.
4. Control of some insect pests.

Because of the many different soil zones and soil types in Saskatchewan it is not possible to give specific directions for soil cultivation which will have more than local application. All that can be done is to establish guiding principles.

The main purpose of fallow in most areas is to conserve moisture, while in others it is to control weeds. Moisture is saved through the control of weeds because **weeds are responsible for practically all of the controllable losses of soil moisture.** Tillage operations should not be done more often, nor to a greater depth than necessary to control weeds, because of the danger of causing drifting.

The general methods of fallowing are given below.

The land should be worked as early as possible in the spring to destroy weed growth. This should be done as often as necessary to control weeds. Tillage implements, such as the one-way disc, duck-foot cultivator and blade type weeders, if properly used, are suitable for weed control and for maintaining the trash cover or lumpy condition of the soil. Speed of implements should usually not exceed three miles per hour unless extra speed is necessary for some special purpose, such as cutting tough roots. High speeds of tillage implements create a soil condition which tends to increase the danger of soil drifting. (See Farm Machinery Section, page 27.)

Temporary modifications of fallowing methods may be necessary during severe outbreaks of insects, such as grasshoppers and sawflies. (See Insect Pests Section, page 91.)

CULTIVATION OF STUBBLE LAND

For the cultivation of stubble land, the same general principles apply, as for fallow. The chief objectives are conservation of moisture and weed and insect control. Fall cultivation which breaks down the stubble so that less snow is held, will result in a smaller amount of moisture being conserved. It also renders the land more susceptible to soil drifting. With the recent introduction of the new types of blade weeders, fall tillage may be done without causing soil drifting. Discing the stubble immediately after harvesting the crop prevents Russian Thistles from growing large in the stubble and conserves the moisture from autumn rains.

In the black and grey wooded soil zones and the southeast part of the dark brown zone, fall tillage is commonly practised for controlling weeds and sometimes permits earlier spring seeding.

Surface tillage in the spring is satisfactory for preparing stubble land for seeding crops in the brown and dark brown soil zones, and in parts of the black and grey wooded zones. Fall or spring plowing may be necessary under certain conditions in the latter zones for the partial control of perennial weeds and to create a friable soil condition. Since weed control is the main reason for soil cultivation, the time and method of doing the work should be determined largely with reference to its effect upon weeds.

SEEDING PRACTICES

Rates of Seeding.—For the common cereals no definite rate of seeding can be recommended as applying to all conditions in the province. The following may be regarded as the normal range of rates for the different cereals and these rates may be modified according to the size and viability of the seed:

Wheat	1 to 2 bushels per acre
Oats	1½ to 3 bushels per acre
Barley	1½ to 3 bushels per acre
Rye	1 to 2 bushels per acre
Flax	30 to 40 pounds per acre

The following conditions demand that the rates be increased, the amount of increase depending on the degree to which the condition is present: (a) weeds, (b) abundant moisture reserves, (c) wireworms. Any or all of these conditions together may justify the higher rates of seeding. Moreover, in districts which are subject to frost damage, heavy rates of seeding wheat are highly desirable to hasten maturity. (See sections on Weed Control, page 74, and Insect Pests, page 91.)

Dates of Seeding.—Specific dates of seeding cannot be stated because of wide variations from season to season. Moreover, with large acreages to cover, it is impossible to do all seeding at the best time. Where drought conditions occur frequently, it is good practice to seed oats and barley first, followed by flax, then wheat. Oats and barley suffer more from late summer drought and grasshopper damage than wheat does, and unless these crops are sown early, yields are usually low. On farms where barley is used as a weed control crop it may be necessary to delay the seeding in order to kill weeds before sowing.

At Saskatoon, mid-May seeding has given best yields in a sixteen-year average for wheat, barley, spring rye and flax. Oats have given best yields when sown May 1 and early seeding is also recommended for rape. Fall rye, sown September 1st, gave best returns in the tests conducted. This data will give some guidance in planning seeding operations, although it may be necessary to vary the dates because of weather or labor management conditions. In general, the best dates would probably be earlier in the southern and later in the northern districts.

Depth of seeding.—Three factors mainly determine the proper depth of seeding: the kind of seed, the depth of the moisture and the firmness of the seed bed. Tillage practice should, as far as possible, be designed to maintain a firm, moist bed close to the surface and seed should be sown into the moist soil. The favorable depth for seeding wheat, oats, barley and rye is usually from two to three inches. Flax should be sown somewhat shallower. The presence of wireworms and annual weed seeds demand not only heavy seeding but as shallow seeding as other conditions will permit. When grasses, clovers and other small seeds are sown, the depth of covering must be shallow. This can be accomplished by preparing a firm seed bed, reducing the drill pressure and removing the covering chains.

FARM MACHINERY AND POWER

TILLAGE MACHINERY

Tillage should be confined to the minimum which will attain the following objectives; moisture conservation, weed and insect control, and soil erosion control. Weed and insect control can largely be obtained with the same tillage operations if these are properly timed. The quality of work done depends largely upon the timeliness of the operation, the soil moisture content, and the condition and adjustment of the machine.

Moldboard Plow.—The moldboard plow may be used where weed and insect control require burying. The use of weed rods, chains, wires or skim coulters greatly assists in completely covering the weeds. The moldboard plow must scour and be sharp to operate efficiently.

Correct hitching, adjustments, and selection of bottoms are essential. For general purpose plowing, the 14" bottom has proven most satisfactory.

Packer.—The function of the packer is to assist in the production of a firm seed bed. The soil must be moist but not wet when being packed if the desired results are to be had. The packer must be of heavy construction or be weighted down for satisfactory results. Where the soil is dry or lumpy, the packer should not be used.

Only subsurface packers are recommended. These packers may consist of either V shaped cast wheels, V shaped assembled discs, or straight blade discs. The straight blade disc type packer is usually drawn behind the oneway disc or drill when seeding in medium to heavy soils. Where wireworm damage is prevalent, packing following seeding is essential.

Sub-Soiling Implements.—Experimental evidence indicates that the use of sub-soiling implements is not justified from the standpoint of increase in yield.

The Oneway Disc.—The oneway disc has proven to be a good general purpose machine for tillage and the formation of a trash cover. Its use on land where trash is not present is dangerous, frequently causing serious soil drifting.

The use of the oneway disc for summerfallowing should be confined to one of the first operations. Repeated oneway discing is not desirable because of the destruction of trash and the excessive pulverizing of the soil. A second operation on clay soils, where heavy combine stubble is present, is often necessary. Experimental evidence is that shallow work from 2½" to 4" is best for all purposes.

In sticky clay soil, the 22" disc with small concavity cleans much more freely than the 24" or 26" disc with greater concavity. The smaller diameter disc with narrow spacing should be used where stubble is short and sparse. The 24" and 26" discs may be used where the stubble is heavy and where greater clearance is essential. Considerable breakage may be expected when using the oneway disc in stony land. Heat-treated alloy steel discs are better for stony land.

Rubber tires on the oneway disc reduce the draft 20% to 30% and improve depth control. In hard ground where difficulty is experienced in penetration, extra weights must be added to the rear furrow wheel and possibly the frame. The hitch for the rubber tired oneway disc must be correctly set.

The cut of the oneway disc may be wider for spring work, but should be narrow for summerfallow in order to cut all weeds and obtain penetration.

Disc Harrow.—The single disc harrow is used as a light tillage implement for early shallow fall discing to secure germination of weed seeds, to expose sawfly stubs and grasshopper pods and for spring discing of stubble for crop. The use of the disc harrow for spring tillage on summerfallow is effective on clay soils but should be used with discretion on all soils because of the danger from soil drifting.

The double disc harrow may be used in clay loam or loam soils where the rear gang will clean. The double disc provides a clean, shallow cut for weeds, leaves the land reasonably level, but tends to cut up the stubble and pulverize the soil excessively where the soil is inclined to drift and the stubble is short.

The Discer (Oneway Disc Harrow).—This machine turns the soil all one way, leaving the surface level and the trash anchored at the surface. It effectively cuts all weeds. Where trash is not present the discer should be used with extreme caution in order to avoid excessive pulverization. Eighteen-inch discs do better work than 16" discs. Better work can be done by using the wider discers at slower speeds (3½ to 4 miles per

hour) than by using the same power to operate narrower machines at higher speeds.

Spike-tooth Harrow.—Care should be exercised in the use of harrows to avoid creating a pulverized, smooth surface favorable to soil drifting.

The spike-tooth harrow is effective in closing the air spaces in spring plowing and in killing small weeds. The quality of the work depends largely upon the moisture content of the surface soil, the sharpness of the teeth and the speed of operation. The use of the spike-tooth harrow causes the spread of perennial weeds where they are present in patches.

The Spring-tooth Harrow and Cultivator equipped with narrow double ended shovels are used for spring tillage on summerfallow as substitutes for the duck-foot cultivator. They are not as effective for the eradication of weeds as the duck-foot, but are more useful in producing a lumpy condition, particularly in heavy soil. They have poor trash cleaning properties. The spring-tooth harrow is not a satisfactory machine for eradicating creeping rooted weeds.

Duck-foot Cultivator.—The duck-foot cultivator has considerable merit in controlling both soil drifting and weed growth. A cultivator in good condition will cut and destroy weed growth and produce a ridged, lumpy soil, favorable to soil drifting control. The cultivator should not be used to attempt to control soil drifting in clay soil where stubble or a trash cover are not present. The three gang cultivator has more clearance for trash and stubble than the two gang cultivator.

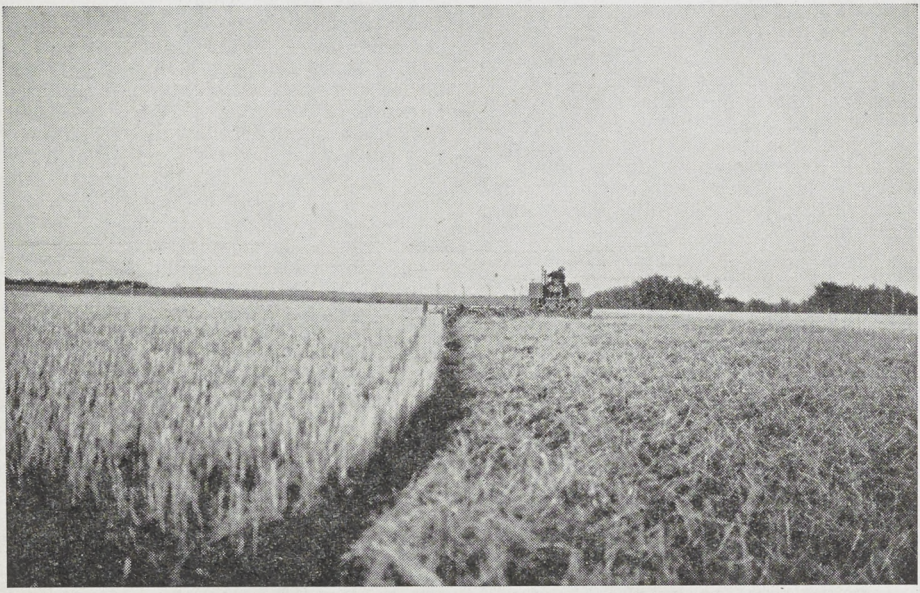
The efficiency of the duck-foot cultivator depends upon the sharpness of the shovels, their scouring in the soil, the alignment and rigidity of the gangs and their shank adjustments, the latter so that the shovels will run flat and clean when operating at shallow depths.

The vertical adjustment of the hitch permits all gangs to operate at the same depth.

The Blade Weeder.—The blade weeder has considerable merit for controlling soil drifting and weed growth in areas where the soil is sufficiently dry to provide a weed kill. It may be fitted with one straight shearing blade, one or two V blades, or two non-cutting weeders.

The Dominion Experimental Station at Swift Current has conducted extensive experiments with this machine. Further information may be obtained by applying to that institution or to your Agricultural Representative.

The Rod Weeder.—These weeders are used as a complementary implement to the duck-foot cultivator or disc harrow.



Trash cover for soil and moisture conservation.

TABLE 1.—Power Required Per Foot of Width, and Draft at Different Speeds

Implement	Depth ins.	Soil	Horsepower required per foot of width						Draft ft. of width 3.5 m.
			2.5 m.p.h.	3.0 m.p.h.	3.5 m.p.h.	4.0 m.p.h.	4.5 m.p.h.	5.0 m.p.h.	
Plow—	4	Clay Loam	1.73	2.24	2.80	3.32	4.08	4.80	300
slow speed	5	Clay Loam	2.00	2.60	3.26	4.00	4.79	5.65	350
Plow—	4	Sandy Loam	1.43	1.86	2.33	2.85	3.42	4.04	250
slow speed	5	Sandy Loam	1.73	2.24	2.80	3.32	4.08	4.80	300
Plow—	4	Clay Loam	1.56	2.02	2.52	2.99	3.67	4.32	270
high speed	5	Clay Loam	1.80	2.34	2.93	3.60	4.31	5.09	315
Plow—	4	Sandy Loam	1.29	1.68	2.10	2.57	3.08	3.64	225
high speed	5	Sandy Loam	1.56	2.04	2.52	2.99	3.67	4.32	270
Disc Plow	4	Clay	2.34	2.96	3.73	4.53	5.40	6.32	400
	5	Clay	2.68	3.44	4.29	5.21	6.24	7.35	460
	6	Clay	3.20	4.12	5.15	6.24	7.44	8.72	550
One-way Disc	2–3	Clay	1.10	1.40	1.73	2.08	2.46	2.86	185
	4	Clay	1.20	1.52	1.87	2.24	2.64	3.07	200
	5	Clay	1.33	1.68	2.05	2.45	2.88	3.33	220
One-way Disc	2–3	Loam	1.07	1.36	1.68	2.03	2.00	2.80	180
	4	Loam	1.13	1.44	1.77	2.13	2.52	2.93	190
	5	Loam	1.27	1.60	1.96	2.35	2.76	3.20	210
Discer	3½	Clay	0.53	0.66	0.80	0.94	1.08	1.23	85
	4	Clay	0.58	0.79	0.99	1.13	1.40	1.60	105
Cultivator	3	Clay	0.80	0.96	1.12	1.28	1.44	1.60	120
	4	Clay	1.07	1.28	1.49	1.71	1.92	2.13	160
Cultivator	3	Loam	0.67	0.80	0.93	1.07	1.20	1.33	100
	4	Loam	0.87	1.04	1.21	1.39	1.56	1.73	130
Disc	2–2½	Clay	0.44	0.54	0.70	0.83	0.96	1.10	75
	3	Clay	0.53	0.66	0.80	0.94	1.08	1.23	85
Disc	2–2½	Loam	0.40	0.50	0.61	0.72	0.84	0.97	65
	3	Loam	0.44	0.54	0.70	0.83	0.96	1.10	75
Rod Weeder	3	Clay	0.57	0.68	0.79	0.91	1.02	1.14	85
	3	Loam	0.50	0.60	0.70	0.80	0.90	1.10	75
Drill (D.D.)	3	Clay	0.40	0.48	0.56	0.64	0.72	0.80	60
	3	Loam	0.37	0.44	0.51	0.58	0.66	0.74	55
Press Drill	3	Loam	0.47	0.56	0.65	0.75	0.84	0.93	70

Their principal usefulness lies in pulling tap rooted weeds. They must be operated from 2½" to 3" deep. The tendency of the machine to firm the soil makes rod weeding particularly valuable in connection with seeding. Their use should be confined to uniform land which is free from rocks, roots, and soddy patches.

The weeder may be used for the last fall operation on summerfallow if operated well under the stubble or trash surface. It is desirable to have the trash and stubble fixed into the soil for protection against winter soil drifting, and for collection of snow.

The Wire or Cable Weeder is used for similar field conditions as that for the rod weeder. Field stones are less damaging to this weeder than to the rod weeder. In tough, heavy stubble or rank weed growth it tends to clog more than the rod weeder.

Snow Plowing and Snow Fencing.—Experiments have indicated that by the use of a snow plow or snow fences considerable quantities of snow can be collected on knolls and other areas where winter or spring soil drifting is apt to occur. Increases in yield have been secured.

SPEED OF OPERATING TILLAGE MACHINERY

The operation of farm machinery at speeds in excess of those for which the machines are designed is uneconomical from the standpoint of cost per acre. Saving in power can be made by drawing larger sized units at slower speeds. Slower speeds (3-4 miles per hour) will provide quality tillage and less pulverization than high speeds (5-6 miles per hour). See Table 1, above.

SEEDING MACHINERY

Grain Drills.—The double disc drill is the standard drill of the Province. The double disc opens the seed bed, permitting the seed to be placed at a uniform depth and covered without excessive loosening of the soil, provided the same tension is maintained on all the pressure springs.

Where soil drifting is prevalent and the soil is readily pulverized, cover chains should not be used.

The single disc drill is still used on land where difficulty is experienced in penetration, especially on land containing considerable sod or trash.

The shoe drill is used on light soils reasonably free from trash where it is important that the soil should not be loosened or pulverized.

The hoe drill is useful where difficulty in peneration is experienced, and is occasionally used in clay soils for ridging when seeding.

The press drill, or press attachment for the standard drill, is used where difficulty is experienced in getting early and uniform germination. The benefits derived from their use are most noticeable in a dry season.

Deep furrow opener attachments have been used effectively for sowing winter wheat.

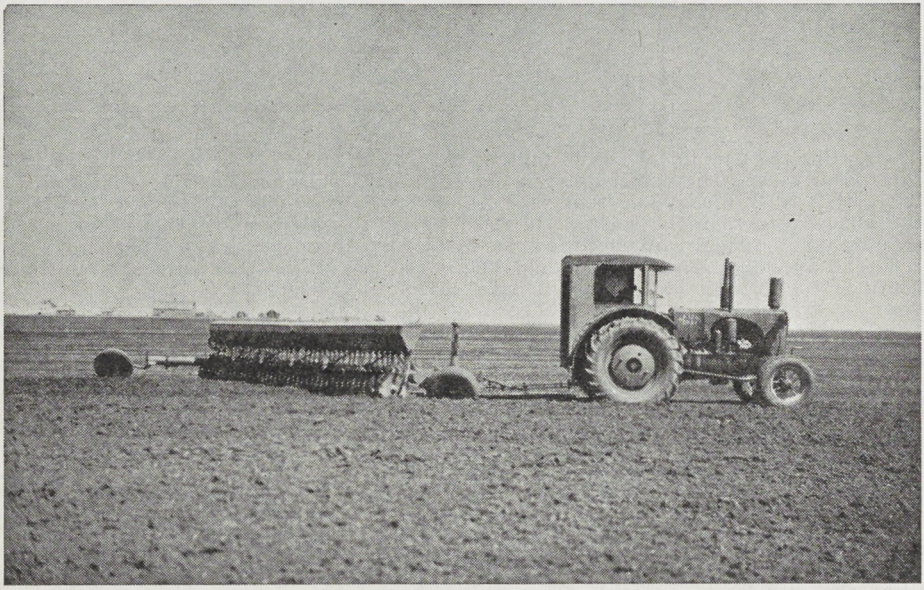
Six-inch spacing for furrow openers seed the grain ideally for competition with weeds and also for supporting the swath when harvesting. The seven-inch spacing has been associated with the fertilizer drill.

There are two types of seed feeds in common use, the fluted wheel and the internal double run force feed. The fluted wheel has been developed specially for wheat and is the simpler of the two. The internal double run force feed has a wider adaptation and a more accurate rate of seeding.

Grass Seeding Machinery. — Grass seeding attachments are not necessary for seeding the kinds of tame grasses used in Saskatchewan.

Grass and legume seeds can be seeded quite satisfactorily with the grain drill. It is recommended, however, that the pressure springs on the furrow openers be released to insure uniformly shallow seeding.

Fertilizer Drills.—With the increased use of chemical fertilizers, attachments have been developed which may be mounted upon the drill quite satisfactorily, as well as upon combination tillage seeding machines. Commercial fertilizer should not be mixed with the seed for drilling as it will corrode and



A uniform and lumpy seed bed.

cause excessive wear of the metal parts of the drill. The fertilizer attachment overcomes this difficulty by placing the fertilizer and grain in separate hoppers which feed with separate mechanisms. Even in the latter case, the fertilizer must be cleaned out of the hopper when the seeding is finished.

Oneway Disc and Discer with Seeding Attachment.—The oneway disc and discer with seeding attachment are designed to disc and seed in one operation. They are used quite economically for seeding stubble land.

It is particularly important that the seed spouts be adjusted uniformly so that the seed will be delivered into the bottom of the furrows at a uniform depth.

Rubber tired equipment has reduced the draft from 20 to 30 percent and has also provided more uniform depth control.

A tandem, flat disc packer with discs spaced to run 3" apart, and also a V shaped disc packer, spaced 6" centre to centre, have been developed to operate behind the oneway disc with the seeding attachment, in clay soils. These packers do not clog in moist clay soil, and they leave the weeds fairly well exposed to the air and sun, without pulverizing the surface of the soil.

It is doubtful whether the flat disc packer is effective in sandy or loam soils. The use of the surface packer immediately following the oneway disc with seeding attachment may to some extent prevent the destruction of weed growth.

Packers must be loaded **heavily** if the desired results are to be obtained.

Plow Drill.—This is a small press drill which can be attached to a moldboard plow or a oneway disc.

A packer is generally necessary between the press drill and the plow or oneway to control the depth of seeding and provide a firm seed bed.

The advantage of the press drill is that in dry areas the land is tilled, seeded and packed in one operation, thus helping to insure speedy and uniform germination. The soil is left lumpy and ridged and this aids in the control of soil drifting.

Calibration of Seeding Machinery.—All seeding machinery must be carefully observed to be sure that the seeding is uniform. Weed control by crop competition depends upon uniform seeding and uniform stands of grain.

The rate of seeding can be checked in the field. This is done on the first round by measuring the amount of seed put in the drill box and the distance required to empty it. Knowing the width of the drill, the area covered can be calculated and then the rate of seeding, i.e.

$$\frac{\text{width in inches} \times \text{miles travelled}}{100} = \text{acres covered}$$

HAYING MACHINERY

Mowers should be checked frequently for alignment of the cutter bar, knife and guards. The power mower with a longer cutter bar has increased acreages per hour over horse mowers by at least 50%. The windrower attachment may be used in light stands of quick drying hay.

Rakes.—Side delivery rakes may be used economically with any type of haying machinery, although high speeds of operation should be avoided. They should not be used on rough or stony land.

Tractor Sweeps.—Large capacity units should have separate wheels. Units with steel pipe fingers represent the most efficient type.

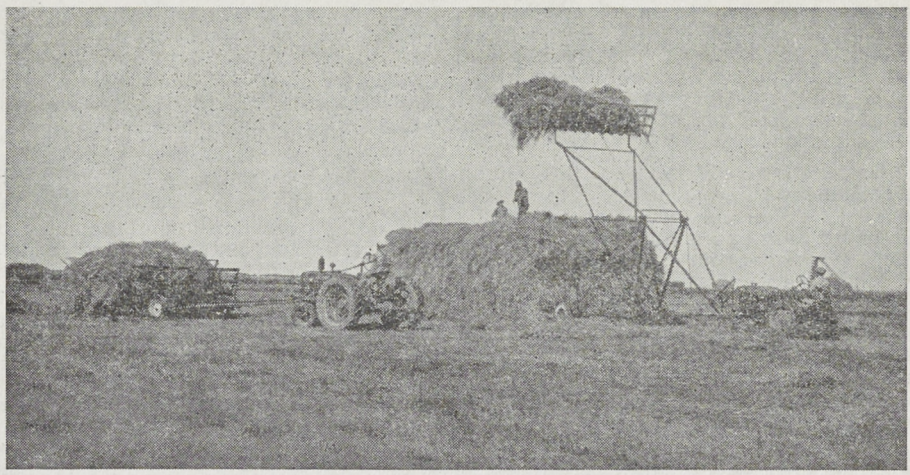
Sweep Stackers require the least man hours per ton in harvesting hay. Stackers are designed for both general purpose and standard tractors so that loose or baled hay can be efficiently handled for either loading or stacking. Sweep stacker methods represent the cheapest means of handling hay when baling is not necessary.

Pick-up Balers perform most economically in processing hay for shipping. They will bale around 3 to 5 tons per hour at a cost of $4-$5 per ton. Much labor is required to gather bales dropped on the ground, and trailers or slips should be used if possible.

Twine tied bales are much harder to handle than wire tied bales, but this method eliminates wire problems.

Pick-up baling **does not** enable one to harvest hay higher in moisture content than can be handled with other methods.

For detailed information with regard to the use of this type of equipment, see your Agricultural Representative.



Hay making with power machinery

HARVESTING MACHINERY

Binders.—The grain binder gives very little trouble if it is cared for when not in use, overhauled before harvest, lubricated well when in operation, operated at the speed for which it was designed, and adjusted carefully when necessary. Rubber tires have reduced draft, provided smoother operation, and increased traction.

The Combine.—Combining has shown a distinct economic advantage over other methods of harvesting in districts suited to its use. The area most suited to the combine is that included in the brown and dark brown zones and part of the black soil area as shown on the map on page 9. It must be stressed that in order to use the combine successfully the ordinary practices of good agriculture must be emphasized. Uniform germination with uniform and early maturity are necessary to successful combine harvesting. Where grain is to be stored it is particularly important to allow the grain to dry to a safe storing moisture content of 14.6% before being combined. Handling the grain does not reduce the moisture content. Any practice that will reduce weed growth and insect injury is essential in combine farming. It is particularly important to operate the combine so that the weed seeds will not be distributed throughout the field. Weed seeds separated from the grain should be carefully bagged and burned.

The special pick-up reel on the combine assists in harvesting "down" or tangled grain.

There are three general types of combines for harvesting grain. The combine with an engine for operating the cutting and threshing mechanisms; the self-propelled outfit fitted with an engine which propels the combine and operates the machine; and the light power take-off driven combines.

The engine driven combine is a desirable unit for pick-up or heavy duty harvesting. Greater flexibility of speed control is available where the tractor and combine are separate units.

The self-propelled combine is convenient for small and irregular fields as well as for large fields. The initial cost is high but the operating cost is relatively low, the large acreage per unit resulting in general economy.

The small power take-off driven combines are light and are usually mounted on rubber tires which lowers the power requirements. The capacity per hour is increased by high speed operation. A large tractor mounted on rubber tires and equipped with a power take-off is required for its operation.

Pick-up Fingers or Extension Guards are not satisfactory for light crops badly infested with sawflies. They are essential, however, in down or tangled grain

where the grain is dry enough to harvest.

The Swather should be large enough to lay a good swath (12 to 16 feet). No difficulty will be experienced in handling a swath 1½ times the width of the combine cutting bar with any of the combines, providing the travelling speeds are slow enough.

Crops which are weedy, uneven in ripening, or sawfly infested, may be swathed to advantage. Grasshopper damage is reduced materially when the grain is placed in the swath.

The swath should be picked up by the combine and threshed as soon as it is dry enough. Losses occur where the crop cannot be picked up and threshed before the fall rains.

The use of the swather provides: (1) the possibility of cutting the grain as early as with a binder, which is of considerable advantage in saving a wheat crop infested by sawflies, (2) protection of the grain in properly formed swaths. The swather can be conveniently used as the header for the header barge. A fair amount of straw should be cut to enable the formation of a good swath. The swathing of a light crop should be avoided. The swath should not be placed in a wheel track or on bare ground and should not be run over by implements.

Straw Buncher.—In combine areas where the straw is required for livestock purposes straw barges have been used with some success. Probably the simplest arrangement is a moderately sized straw buncher which trails behind the combine.

The Header.—The header (usually 12-foot) is used to harvest short crops. The grain is cut and elevated into header racks drawn alongside and stacked conveniently for threshing. As much straw as possible should be cut with the grain to provide ventilation in the stack.

The stacks should be built to provide maximum ventilation and protection against wet weather. The size and shape will depend upon the moisture content of the grain and the weeds present. Generally they are made narrow, long, high and well tramped in the centre to ensure protection against wet weather.

Header Barge.—The use of the header barge in harvesting grain has considerable merit for short crops. The majority of barges used in the Province have been home-made. Factory made barges have been used more or less satisfactorily in the southern and western parts of the Province. There seems to be no particular advantage in one machine over another with respect to the type of stack built. The quality of the stack depends upon the ability of the operator to build it **high in the centre all the way from the bottom** so that it will shed the rain. Poorly built stacks have resulted in sprouting as much as 50%, where well built stacks have offered ample protection from wet weather.

Threshing Barged Stacks.—The combine can be used to thresh barged stacks. It is drawn from stack to stack. It is desirable where possible to slow down the platform for hand feeding.

The Threshing Machine with ample capacity operates more efficiently than the smaller machine which is overloaded. The threshing machine gives very little trouble if cared for when not in use, overhauled before harvest, and lubricated carefully when in operation. The operator should be familiar with the adjustments of the various parts of the machine. The grain should be pitched into the feeder uniformly with the heads toward the band cutters, excepting that when threshing malting barley the butts should be fed first in order to reduce damage to the kernels. The engine driving the thresher should have ample power to maintain the rated cylinder speed.

The threshing machine with an extension feeder can be used for threshing either barged stacks or stooks. The stacks or stooks may be conveyed quite conveniently to the machine by suitably constructed sweeps. Home-made tractor power sweeps have been more satisfactory than the lighter sweeps designed for handling hay.

SEED CLEANING MACHINERY

There are two types of fanning mills in general use; one depending upon sieves and screens primarily to measure the length and width of the kernels, with the blast being used only to remove the dust and chaff; the other uses the blast for the primary grading based upon the weight of the kernels, with

screens and sieves for taking out the coarse material and weed seeds.

It is frequently necessary to run the grain through the fanning mill twice; first, for removing coarse material, and second, for grading.

The best work is done when the fanning mill is equipped with the proper sized sieves and screens to suit the grain being cleaned. The mill should be operated steadily at the correct speed and fed at rated capacity. Extra material is available to make up any sieves required. Sieves of various sizes are available from the companies handling fanning mills. When in doubt, the proper size sieve or screen can be determined by sending a sample of the grain to the Production Services, Plant Products Division, Federal Building, Saskatoon, or to the Field Husbandry Department, University of Saskatchewan.

Specialized grain cleaning machinery of the wire drum, disc, or indent cylinder types, has been developed and combined to form commercial cleaning units. Combination units are convenient as itinerant units for large areas. For further reference, obtain the seed cleaning bulletin from the Extension Department, University of Saskatchewan, or your Agricultural Representative.

MISCELLANEOUS MACHINERY

Grain Grinders.—Feed grinders of the plate type are suitable for grinding feed for livestock into fine, medium or coarse grades. The weed seeds in the grain will be crushed when the feed is ground fine or medium, but they may go through unbroken in coarse grinding. Higher speeds of operation tend to crush more weed seeds.

Feed crushers of the roller type prepare grain ideally for horse feed, and without producing dust. Weed seeds, however, are not destroyed by this machine. The power requirement for the roller mill is low.

Hammer mills of various sizes and designs may be used for grain grinding. The hammer mill must be operated at high speed to function correctly. It requires considerable power. It cannot be operated satisfactorily with less than the required power even though the capacity is reduced. The hammer mill will grind grain to any desired fineness when fitted with screens of the proper size.

Roughage Grinders.—The hammer mill will grind roughage to any desired fineness provided the proper screen is used. The finer the grinding the lower the capacity of the mill. The roughage must be dry, as damp material cannot be ground or even broken up coarsely. Some hammer mills are fitted with cutting knives that cut the roughage into short lengths as it passes into the hammers and screen. Roughage inclined to be damp can be cut and partially shredded with the large size screen by hammer mills equipped with knives.

The combination cutter and plate grinder has been developed to cut and grind in one operation. It may also be used independently as a grain grinder or as a roughage cutter. Roughage must be dry when being ground with this machine.

Roughage Cutters. — This cutter is fitted with knives so that roughage may be cut to any desired length. It will cut any kind of feed, green or dry. The power requirement for cutting is considerably lower than for grinding.

All grain grinders, roughage grinders and cutters are fitted with baggers, blowers, and dust collectors, for convenience in handling the processed feed.

Grain Handling Equipment.—Portable elevators of the auger and drag line type operated by a stationary engine serve as grain handling equipment for car and bin loading. An auger type elevator may be mounted on the box of the truck in such a manner as to load grain into the truck from the granary or to unload from the truck. The auger is driven by the power take-off from the truck motor. Grain blowers, stationary and truck mounted, are also used in handling grains and grasses. Care must be taken to operate the grain blower at the correct speed and feed it at full capacity to prevent undue grain cracking.

Suitably constructed overhead hoppers for use with the thresher are valuable. Dump boxes or auger bottom boxes speed up grain handling with the truck.

Land Clearing Machinery.—Home-made brush cutters driven by heavy farm tractors are used satifactorily in poplar and willow brush not larger than 5″ or 6″ in diameter. Trees cut flush with the ground leave roots which can be plowed out with a brush breaker. After the poles have been trimmed and removed, the brush can be piled with a home-made brush piler and tractor. For brush heavier than 5″ to 6″, the com-

mercial heavy duty brush cutter with the large crawler tractor is the only satisfactory type of unit.

The standard 20" to 26" brush breaker used singly or in tandem with tractors of ample power break the land to any desired depth. The roots may be removed by using a home-made A shaped root harrow. Subsequent tillage may be accomplished with ordinary farm tillage machinery.

Grain Drying.—The most satisfactory procedure when combining is to field-dry all grain before combining. Grain should not be threshed tough or damp unless satisfactory drying facilities are available. Artificial drying is an expensive process.

Spraying and Dusting Machinery.—A number of types of sprayers and dusters are available for agricultural purposes. High pressure sprayers (400 pounds per square inch) are used in spraying trees and livestock. The cost of modifying these for field spraying is prohibitive.

The field application of chemicals for insect and weed control may be effected with either low pressure sprayers (20-40 pounds per square inch) or field dusters. More research is necessary to determine the possibilities and limitations of chemical weed control.

Spraying vs. Dusting.—The development of low volume nozzles for spraying machines has increased the popularity of spraying. The advantages of spraying are (1) More even distribution, (2) Better control of drift in winds, (3) Materials not affected by moisture. The advantages of dusting are: (1) Requires no water, (2) Lighter weight of equipment, (3) Can be applied at higher speeds.

TYPES OF MACHINES

1. The most popular method of applying 2,4-D is with the low volume boom type sprayer which may be either tractor, truck or trailer mounted. Due to the relatively low cost of this equipment, it is also best suited to individual ownership. As timeliness is important in the applying of 2,4-D, there is merit in each farmer owning his own machine. All boom type sprayers should be operated at speeds of approximately 4 miles per hour. If speeds are increased, the whipping of the booms becomes serious, causing breakage and uneven application. A simple method of determining acreages covered is to use the following table:

$$\frac{\text{width of boom in inches} \times \text{distance travelled in miles}}{100} = \text{acres}$$

2. High velocity air stream machines of the turbine type spread the chemicals in either fog or dust form. The turbines may be mounted on a trailer or truck as they are self-contained units. It should be moved at a speed of about 7 miles per hour and will cover 25 to 30 acres per hour when running continuously. It is most suitable for use in large fields and where 1500 or more acres of crop land are to be sprayed in one season. It should not be used in areas where drifting dust or fog will endanger trees or susceptible crops.

3. Boom type dusters are mounted on the tractor so that power to drive the duster fan may be obtained from the power take-off. Some difficulty has been experienced in obtaining even distribution of dust because of the small cross sectional size of the boom. Long booms have not been entirely satisfactory since the dust tends to clog in the boom. Some loss of chemical through drifting has occurred with the duster. Guard aprons attached to the boom have not helped this problem materially. Because of the drifting problem, dusting cannot be accomplished in windy weather.

4. Spraying from aircraft has been successful when fuel oil rather than water is used as a carrier for the 2,4-D. The water evaporates rapidly before reaching the foliage, particularly when applied with the conventional aircraft.

Observations to date have given no evidence of corrosive injury to the tractor or truck, its paint job or the rubber tires, from 2,4-D spray or dust.

Field spraying and dusting machines may be used in applying insecticides. Due to the poisonous nature of some insecticides, caution is necessary. (See page 100, Insect Pest Section.)

FARM POWER

Farm power in Saskatchewan has rapidly become tractor power, but well balanced horse units still have an economical place on some farms. The development of the rubber tired tractor, in a large range of sizes (from one to five-plow) has provided power suitable for most farm needs. The general purpose tractor with hydraulic controls and a wide variety of equipment is well suited for the mixed as well as the grain farm.

Two main factors must be considered when selecting a tractor, first the type of engine and second the type of traction.

The high compression gasoline engine meets the needs of a wide range of farm requirements demanding easy starting, part load operation, idling, as well as heavy duty long operation. The narrowing of the spreads and increasing costs of fuel have eliminated the economy of the low compression tractor and hastened the trend toward the use of high compression gasoline and Diesel engines.

The Diesel engine offers the most economical power. When 1,000 or more hours per year of operation are available, the higher initial costs will be repaid by fuel savings. Careful operation and the use of clean fuel are essential to successful Diesel engine operation.

Over 90% of the tractors sold in Western Canada in 1947 were on rubber tires. Rubber tires when loaded with liquid and cast iron to provide traction with less than 10% slippage, are responsible for fuel savings of from 17% to 30% and also increased power of 25% to 30% over that of steel wheels. Steel wheels or crawlers should be used in bush land for brush cutting, breaking, and working new land. The crawler operates with less slippage and at an average fuel saving of 11% over the steel wheeled tractor. The crawler is most advantageous in hilly and soft land. It is the only satisfactory traction for tractors larger than the 5-plow size. Multiple units of two or more machines are economically drawn by crawler tractors.

True economy in machine operation is derived from correct balance between power and machinery size. The tractor operates most efficiently when loaded from ¾ to full load capacity. Thus, machines of such size as to load the tractor to this capacity should be used.

Table 2, below, indicates the correct size of **machinery** for tractors of various rated drawbar horsepower. The drawbar horsepower used in the table is independent of wheel equipment and consequently applies to any tractor on steel, rubber or crawlers.

Inflation Pressures for Tractor and Implement Tires Operating Under 20 M.P.H.:

1. **Tractor Rear Tires** should be filled with calcium chloride liquid, 75% to 100%, as required for weight to reduce slippage. A minimum pressure of 16 pounds per square inch should be maintained and additional pressure should be added if necessary to prevent side-wall flexing.

2. **Tractor Front Tires** may or may not require liquid filling for extra weight. Tire pressures should be sufficiently high to prevent side-wall flexing. Minimum pressure 25 pounds.

TABLE 2.— Balanced Power and Machinery Units Based on Rated Drawbar Horsepower of the Tractor on Level to Slightly Rolling Land.

Implement	Soil Texture	Depth	Recommended Miles/hr.	Tractor Size					Draft/ ft. of Wid.
				1 plow	2 plow	3 plow	4 plow	5 plow	
				9 h.p.	12.5 h.p.	17 h.p.	22.5h.p.	29 h.p.	
Plow— slow speed moldboard	Clay Loam	4-5"	3-3½	2F.12"	3F.12"	3F.16"	4F.16"	6F.14"	470
	Sandy Loam	4-5"	3-3½	2F.14"	4F.14"	4F.14"	5F.14"	7F.14"	370
Plow— high speed moldboard	Clay Loam	4-5"	4-5	1F.16"	2F.14"	3F.14"	4F.12"	4F.16"	428
	Sandy Loam	4-5"	4-5	2F.12"	2F.16"	3F.16"	4F.14"	5F.14"	350
Disc Plow	Clay	5"	3-4	2F. 9"	3F.9"	4F. 9"	5F. 9"	7F. 9"	550
One-Way Disc	Clay	3-4"	3-5	4¼ft.	6ft.	8ft.	10ft.	2/7ft.	220
One-Way Disc	Loam	3-4"	3-5	4½ft.	6¼ft.	8½ft.	2/5½ ft.	2/7½ ft.	210
Discer	Clay	3-4"	3-4½	——	10ft.	16ft.	19ft.	19ft.	105
Cultivator	Clay	3-4"	4-4½	4½ft.	6¼ft.	8¼ft.	11¼ft.	15ft.	160
Stiff tooth	Loam	3-4"	——	5¾ft.	8ft.	10ft.	14ft.	18ft.	130
Single Disc	Clay	3½"	3-4½	10ft.	14ft.	21ft.	28ft.	2/18ft.	85
Single Disc	Loam	3½"	3-4½	12ft.	16ft.	24ft.	2/16ft.	2/21ft.	75
Rod Weeder	Clay	3"	4-4½	9ft.	12ft.	16ft.	22ft.	2/14ft.	85
Rod Weeder	Loam	3"	4-4½	10ft.	14ft.	18ft.	24ft.	2/16ft.	75
Drill— double disc	Clay	3"	4-5	10ft.	14ft.	2/10ft.	2/14ft.	3/12ft.	60
	Loam	3"	4-5	12ft.	16ft.	2/12ft.	2/14ft.	3/12ft.	55
Press Drill	Loam	3"	4-5	9ft.	12ft.	18ft.	2/12ft.	3/10ft.	70

3. **Farm Implement Tires.**—The loads which can be carried by farm implement tires are proportional to the size and inflation pressure of the tire. It is unwise to use undersize tires or to overload them. The inflation pressure should always be high enough to prevent sidewall flexing. All tires have a maximum load limit. For load information, see your tire or implement agent.

CARE OF FARM MACHINERY

Because of the longer life expectancy built into farm machinery it is more important than ever to care for machinery when not in use. Farm machinery should be housed in a shed or otherwise adequately protected.

1. When finished with a machine or piece of equipment, clean it thoroughly.
2. Check the entire machine for worn, broken or bent parts and order repairs immediately.
3. All bearings should be greased thoroughly.
4. Protect polished surfaces from rust by thoroughly covering with a heavy body grease or commercial rust preventive.
5. Remove, clean and dry canvasses, rubber belts and rubber tires, and store unless the machine is properly housed.
6. When tires are left on the machine for long periods, the load should be removed. The tires may be painted with a tire paint and must be left inflated.
7. Support all working parts away from the ground.
8. Protect against wind and weather by adequate painting.
9. Protect machinery from livestock and poultry.
10. Drain radiators, fuel tanks and carburetors and cover motor openings against moisture and dust.
11. Oil each combustion chamber of the engine through the spark plug openings and replace the plugs.
12. Periodically turn the engine with the crank to prevent valve and ring sticking.

OTHER INFORMATION AVAILABLE

Bulletins and circulars are available on many farm engineering topics, such as the operation, adjustment and care of plows, oneway discs, swathers, barges, bunchers, sweeps, binders, combines, grain cleaning, handling and drying equipment; engine fuels and lubrication; care, operation and overhauling of the tractor, etc., etc. Requests for bulletins should be addressed to Department of Extension, University of Saskatchewan, Saskatoon, or to your Agricultural Representative.

CEREAL CROPS

On the whole the recommendations given here apply particularly to 1948. Revised cereal variety recommendations are published annually. A copy of the recommendations may be obtained free of charge about January 15th each year from the Extension Department, University of Saskatchewan, Saskatoon, the Dominion Experimental Stations of the Province, or from your Agricultural Representative.

CEREAL VARIETY ZONES

Among all the influences on cereal varieties, it has been found that the soil-climatic environment is of major importance. There are four main soil-climatic zones in Saskatchewan, namely, 1, 2, 3, and 4. To facilitate the making of specific variety recommendations, it has been necessary to divide the soil-climatic zones into cereal zones. The cereal zones are designated by the addition of a letter to the soil-climatic zone number.

Only those varieties are recommended for use in the different zones which appear to warrant general usage over relatively large areas. Although a local soil-climatic condition may vary widely from the average for a zone, it will usually be found that one of the recommended varieties will be satisfactory for such a situation. Information on the local adaptation of varieties can always be obtained from the University or the nearest Dominion Experimental Station.

Special Considerations

The present trends in the small grain crops are toward:

(1) more wheat and barley and less oats on the dry open plains, particularly in the South-west.

(2) more barley, oats and flax and less wheat in the park belt and forest areas of the East and North.

The following points deserve special mention. (1) Wheat, barley, oats and rye require in general the same basic seeding rates when expressed in pounds per acre, whereas flax requires approximately a third as much. (2) Barley, rye and flax are fairly sensitive to depth of seeding and should not be sown deeper than is necessary; however, the depth required may vary considerably with the soil type. (3) In the drier parts of Saskatchewan oats and barley should be sown early. (4) Flax should always be sown into warm, moist, firm soil, even though seeding has to be delayed to have the right conditions. (5) The new chemical weed killers bid fair to revolutionize flax production, as weeds in the flax crop and in the succeeding crop have for years been the most serious handicap to the flax grower.

VARIETY RECOMMENDATIONS

Following are the principal recommendations for 1948. For 1949 and 1950 there may be alterations in these recommendations according to changes which may occur in the varietal situation. Promising new varieties now under test may be added for certain zones and some of the older varieties may be no longer recommended for areas where they are excelled definitely by newer varieties. It is suggested that the reader keep up to date by obtaining each year the latest recommendations as mentioned previously. It also should be kept in mind that the variety considered best in one situation may not be best under other circumstances in the same zone.

THE VARIETIES ARE GIVEN IN ALPHABETICAL ORDER FOR EACH ZONE
(not including special purpose varieties)

Zone	*Prevailing Soil and Climate*	Wheat		Oats	Barley	Flax
		Bread	**Durum**			
1A	Brown soils; subject to frequent droughts	Rescue† Thatcher	Pelissier Stewart	Ajax Fortune	Titan	Royal◈
1B	Brown soils; subject to more frequent droughts than 1A	Rescue† Thatcher		Ajax□	Titan	Royal◈
1C	Brown soils, chiefly burn-out types; subject to more frequent droughts than 1A	Rescue† Thatcher	Pelissier Stewart	Ajax□	Titan	Royal◈
2A	Dark brown soils; subject to occasional droughts; better moisture conditions than 1A	Thatcher	Stewart	Ajax Exeter Fortune	Plush Titan	Royal
2B	Dark brown soils; slightly cooler than 2A	Thatcher	Pelissier Stewart	Ajax Exeter Fortune	Plush Titan	Royal
2C	Dark brown soils, bench land; cooler, shorter frost free season and better moisture conditions than 1A	Rescue† Thatcher		Ajax	Titan	Royal
2D	Dark brown soils; higher elevation and distinctly shorter frost free season than 2B	Rescue† Thatcher		Ajax Exeter Fortune	Plush	Royal
2E	Dark brown heavy clay soils; more drought resistance than 2A and 2B	Apex Regent Thatcher	Stewart	Exeter Fortune	Plush Titan	Royal
2F	Brown and dark brown heavy clay soils; more drought resistance than 1A and adjoining 2B	Apex Rescue† Thatcher		Ajax Victory	Titan	Royal
3A	Black soils; better moisture conditions than 2A	Redman Thatcher	Stewart	Exeter Fortune	Montcalm Plush Vantage	Dakota Royal
3B	Deep black and degraded black soils; shorter frost free period and better moisture conditions than 3A	Redman Regent Thatcher		Exeter Fortune	Montcalm Plush Vantage	Dakota Redwing Royal
3C	Black soils; better moisture conditions than 2B, and cooler than 3A, 3C and 3G	Redman Regent Thatcher	Stewart	Exeter Fortune	Montcalm * Plush Vantage	Royal
3D	Deep black soils; better moisture conditions than 3E	Redman Thatcher		Exeter Fortune	Hannchen Montcalm * Plush Vantage	Redwing Royal
3E	Black soils; shorter frost free season and better moisture conditions than 2D	Thatcher		Ajax Exeter Fortune	Montcalm * Plush	Dakota Redwing
3F	Degraded black and some grey soils; shorter frost free period than 3D	Thatcher		Exeter	Hannchen Montcalm Plush Vantage	Redwing
3G	Black soils, medium to light textured, more droughty than 3E	Thatcher		Ajax Exeter Fortune	Plush	Redwing
3H	Degraded black soils; distinctly short frost free season	Redman		Fortune Victory	Montcalm	Redwing
4A	Gray and strongly degraded black soils; short frost free season	Thatcher		Exeter	Montcalm	Redwing Royal
4B	Gray soils; distinctly short frost free season; better moisture conditions than 3E	Thatcher		Exeter Fortune	Montcalm	Dakota Redwing

†For sawfly control only.

*See the description of Montcalm in the text.

□Oats as a crop are not recommended for this zone, but for those who do grow oats the variety Ajax is suggested.

◈Flax as a crop is not recommended in Zone 1, and is hazardous to grow at many points in Zones 1A and 1B, but for those who do grow flax the variety Royal is suggested.

CEREAL VARIETY ZONES

BREAD WHEAT

Recommended Varieties

These are varieties of oustanding merit for one or more of the zones. In all cases they are hard red spring varieties **resistant to stem rust** and of proven excellence.

Thatcher has wide adapatability and is recommended for all zones except 3H. It has short, strong straw, early maturity and high resistance to shattering. The kernels are small and tend to bleach when exposed to weathering. It is moderately resistant to common rootrot and resistant to loose smut, but susceptible to leaf rust and bunt.

Apex.—Compared with Thatcher it has somewhat longer but weaker straw, slightly later maturity and equal resistance to shattering. The kernels are slightly larger, brighter, and have less tendency to bleach. It is moderately resistant to rootrot, bunt and loose smut, and moderately susceptible to leaf rust. The new Apex, Sask. 2177, compared with the old Apex is higher in yield,

stronger strawed, higher in bushel weight and one day later.

Regent.—Compared with Thatcher it has slightly weaker straw of equal length, earlier maturity and equal resistance to shattering. The kernels are larger and have less tendency to bleach. Regent is resistant to some races of leaf rust but susceptible to a number of races prevailing at the present time. It is resistant to most races of bunt but moderately susceptible to a few, moderately susceptible to rootrot and moderately resistant to loose smut.

Rescue.—Compared with Thatcher it has weaker straw of equal length, slightly later maturity and equal resistance to shattering. The kernels are larger, brighter and have less tendency tc bleach. It is moderately susceptible to common rootrot, susceptible to bunt, loose smut and leaf rust. The chief characteristic of this variety is its resistance to wheatstem sawfly damage.

Redman.—Compared with Thatcher it has straw of equal length and strength, slightly earlier maturity and equal resistance to shattering. The kernels are larger and have less tendency to bleach. Redman is resistant to many races of leaf rust but moderately susceptible to those prevailing at the present time. It is resistant to bunt, moderately resistant to loose smut, and moderately susceptible to rootrot.

Varieties Not Recommended

Marquis is an awnless stem rust susceptible variety. **Compared with Thatcher** Marquis averages lower in yield, has longer slightly laxer heads, larger brighter kernels with less tendency to bleach, longer straw of equal strength, two to four days longer ripening period, equal resistance to shattering, after-harvest sprouting, common rootrots and spring frosts, less resistance to loose smut and slightly more resistance to bunt. "Varietal surveys indicate that many farmers in Western Saskatchewan still grow this variety, although scores of accurate comparable results in that part of the Province show greater returns from Thatcher and Rescue."

Reliance is an awned variety. **Compared with Thatcher** it has somewhat longer, weaker straw, considerably later maturity and less resistance to shattering. The kernels are larger, brighter, and have less tendency to bleach or to shrink under extreme dry conditions. It is moderately resistant to rootrot, but susceptible to loose smut, bunt, leaf rust and stem rust.

Renown is a medium early, stem rust resistant variety with many excellent characteristics, but insufficient yielding capacity under most Saskatchewan conditions.

Red Bobs.—Compared with Thatcher it has straw of equal length and strength, equal maturity and distinctly less resistance to shattering. The kernel is larger and brighter but has a greater tendency to be starchy under moist conditions. It is moderately susceptible to rootrot, and susceptible to leaf rust, bunt and loose smut, and **very susceptible to stem rust.**

Garnet is a vigorous, early maturing variety which is still grown somewhat in Northwestern Saskatchewan in spite of its **high susceptibility to rust,** weak straw, propensity to sprout in the stook, and in spite of being graded separately.

Others: Newthatch, Rival and Mida.

Promising Varieties Under Test

Saunders.—Compared with Thatcher it has slightly shorter straw of equal strength, is one day earlier maturing and has equal resistance to shattering and loose smut. The kernels are larger with less tendency to bleach. Saunders is susceptible to leaf rust and moderately susceptible to covered smut and black chaff.

DURUM WHEAT

Durum or macaroni wheats have a place in the farm economy in certain areas of the Province. They have proven valuable in the sawfly infested area on account of their moderate resistance to this insect pest. They are later maturing and weaker in the straw but, in zones where they are recommended, usually yield as much as and frequently more than the bread wheats.

Recommended Varieties

Stewart is of good quality and is eligible for the top grades. It has moderately strong straw, is resistant to stem and leaf rust but is susceptible to bunt and moderately susceptible to common rootrot.

Pelissier.—Compared with Stewart it is inferior in quality and not eligible for grades above 3 C.W. It has stronger straw, is susceptible to stem and leaf rust, bunt and common rootrot. It has outyielded Stewart in the drier parts of the Province.

Varieties Not Recommended

Mindum is the standard durum variety as regards macaroni quality, but it is being superseded in Saskatchewan by Stewart, which yields better.

Golden Ball. This variety is so poor in macaroni quality that its license for sale as seed was revoked some years ago.

Carleton is a sister of Stewart but lower in yield.

WINTER WHEAT

While winter wheat is not recommended for general use in Saskatchewan, it is being grown more or less satisfactorily in Zone 1C and some parts of Zones 3B, 3H, 4A and 4B. The advantages of winter wheat, where it winters successfully, are that it excels spring wheat in yield and in getting ahead of late summer drought and early fall frosts. It is worth noting that breeding and testing work on this crop is under way.

At the present time the varieties **Kharkov** and **Yogo** are being used. Both are hard, red winter wheats with awned heads and narrower longer kernels than Thatcher. They are susceptible to stem rust and moderately winter hardy. The variety Yogo is considered hardier than Kharkov.

OATS

On the dry open plains, where oats are often a disappointing crop, it is recommended that they be sown early on summerfallow or other well prepared land. The recommended varieties all have open panicles and white seed.

Recommended Varieties

Exeter is a late maturing large seeded variety which yields well in the cooler, moister areas of Saskatchewan. It has slightly weak straw of good length. It is resistant to most races of stem rust but susceptible to some, and moderately susceptible to leaf rust and smuts.

Ajax is an early maturing variety with strong somewhat short straw. It is resistant to most races of stem rust, but susceptible to some, and has moderate resistance to leaf rust and smuts. It has a somewhat small kernel but has yielded well in the drier areas of the Province and is useful in other areas where frost is a hazard.

Victory is a late plump seeded variety which yields well where rust is not a factor. It has slightly weak straw of good length and is susceptible to smuts and rusts.

Fortune is a new high yielding, smut resistant oat which possesses rust resistance similar to that of Exeter. This variety compared with Exeter is equal in yield, slightly earlier and stronger strawed.

Varieties Recommended for Special Purposes

Valor is a very early maturing variety with large plump kernels and strong straw. Because of its earliness and large seed it is useful as a cleaning crop for wild oats. It is susceptible to rusts, but resistant to smuts.

Brighton is a high yielding hulless variety with large kernels; is moderately resistant to smuts, but susceptible to rusts. It is useful for special purpose feeding such as young pigs, cattle and poultry.

Varieties Not Recommended

Banner resembles Victory closely in adaptability, lateness, yielding ability, length and strength of straw and susceptibility to disease. Banner has a somewhat more slender kernel and is better adapted to dry conditions than Victory.

Legacy. Compared with Victory Legacy is earlier and has stronger straw but has not yielded as well under Saskatchewan conditions.

Laurel is a high yielding hulless variety with strong, short straw. It is a week earlier than Banner and yields about two-thirds as much threshed grain. Laurel is useful for special feeding purposes as for poultry and pigs.

Garry is a new variety, resistant to the rusts and smut. It has not yielded as well as Ajax or Exeter in Saskatchewan. Garry is strong strawed, later in maturity than Ajax but earlier than Exeter. It is susceptible to Helminthosporium victoriae, a serious root rotting disease.

Others: Anthony, Beacon, Beaver, Cartier, Eagle, Erban, Gopher, Vanguard.

Promising Varieties Under Test

Larain is an early maturing, strong-strawed variety with plump kernels. It may prove useful as a special purpose oat in certain parts of Saskatchewan.

BARLEY

Barley is now being grown extensively on the open plains where, under good conditions, it gives more feed units per acre than either wheat or oats. It is recommended that barley in this area be sown early on summerfallow or other well prepared land. In the moister parts of Eastern and North-eastern zones a considerable amount of barley is grown for malting purposes as well as for feed.

Varieties Recommended for General Use

Plush is a six-rowed, smooth-awned, medium late, high yielding variety with moderately strong straw. It is moderately resistant to stem rust but susceptible to leaf rust, loose and covered smut. It is reasonably satisfactory for combining and is eligible for feed grades only.

Montcalm is a six-rowed smooth-awned blue seeded variety of high malting quality. It has moderately weak straw and is poor for combining. Montcalm is eligible for grade 1 C.W. six-row. It is susceptible to rusts and loose smuts, but moderately resistant to covered smut.

Titan is a six-rowed, smooth-awned early maturing, strong strawed variety which yields well. It is a good combine variety and is eligible for the feed grades. Titan is susceptible to rusts but is resistant to both loose and covered smut.

Hannchen is a two-rowed, rough-awned late maturing variety which has moderately weak short straw and is satisfactory for combining. It is eligible for the top two-row grades. Hannchen is susceptible to rusts and smuts.

Vantage is a six-rowed, smooth-awned, medium late variety, resistant to stem rust. **Compared with Plush,** Vantage has stronger straw, greater neck strength, is more resistant to shattering and has similar susceptibility to leaf rust and to loose and covered smut.

Varieties Recommended for Special Purposes

O.A.C. 21 has been the standard malting barley in the past, but is being largely replaced by Montcalm for agronomic reasons. O.A.C. 21 is a six-rowed, rough-awned blue seeded variety with a weak neck and prone to shatter.

Warrior is the best available hooded (awnless) variety. It is very useful where early maturity is required. It has strong straw and is satisfactory for combining. It is susceptible to rusts, moderately resistant to covered smut and resistant to loose smut. Warrior is eligible for the feed grades.

Varieties Not Recommended

Newal is a six-rowed, smooth-awned strongly nodding variety. **Compared with Plush,** Newal is equal in general yielding ability, time of maturity, straw length and strength, bushel weight and susceptibility to diseases. Newal excels Plush in the northwest whereas Plush excels Newal in the southeast.

Regal is a six-rowed, smooth-awned variety which, **compared with Plush,** is lower in yield, a day later, has stronger straw of equal length and is more susceptible to rusts but less susceptible to smuts. Regal continues to do well in the northwest.

Prospect is a six-rowed, smooth-awned early maturing variety. **Compared with Plush,** Prospect averages lower in yield and bushel weight, equal in straw length and strength and similar in disease reactions. Prospect does well in the southwest, excelling Plush in most years.

Rex is a two-rowed, smooth-awned variety. **Compared with Plush** Rex averages lower in yield, equal in time of maturity and straw length, similar in disease reactions, distinctly higher in bushel weight and much higher in straw strength and in resistance to shattering and neck breaking. On account of the last three characteristics Rex is popular as a combine barley.

Olli is a nodding, six-rowed, rough-awned variety with blue seeds. It is very early maturing and yields fairly well under moist conditions in the north-eastern part of the Province, but its yield on the open plains is comparatively poor. It is susceptible to rusts and smuts.

Others: Canadian Thorpe, Colsess, Himalayan, Mensury, Sanalta, Trebi, and Wisconsin 38.

Promising Varieties Under Test

Compana is a two-rowed, smooth-awned variety, released by the Montana Experimental Station as a dry land feed barley. It combines well and resists grasshoppers better than most varieties. If licensed for sale in Canada it will be useful in the drier parts of southwestern Saskatchewan.

Velvon II is a six-rowed, smooth-awned variety which has shown a great deal of promise. It is an excellent combine variety. If licensed for sale in Canada it will probably replace Plush in northwestern Saskatchewan.

FLAX

To control flax diseases it is advisable to treat the seed every year with ceresan or a similar mercuric dust at the rate of 1½ ounces per bushel. In addition, as most of the diseases overwinter on the straw, flax should not follow flax.

Recommended Varieties

Royal is moderately resistant to wilt and rust, but is susceptible to pasmo. It has medium-sized light brown seeds with a characteristic shading off toward very pale brown at the big end. Royal is a high yielder, is late maturing and has slightly weak straw.

Redwing is resistant to wilt, susceptible to rust and pasmo and has small brown seeds. It is lower in yield than Royal but as it matures a week earlier it is recommended where early maturity is essential.

Dakota is highly resistant to both wilt and rust and appears to be moderately susceptible to pasmo. It has medium-sized brown seed. Dakota matures earlier and more uniformly than Royal but is slightly lower in yield.

Varieties Not Recommended

Viking is a variety having white blossoms and very large yellow seeds. Compared with Royal it is equally late and has much shorter straw. Viking is highly resistant to rust and wilt, but very susceptible to pasmo. It is high in oil extraction and quality.

Victory is a variety with white blossoms and large brown seeds. Compared with Royal it is equally late and has shorter straw. Victory is highly resistant to rust and wilt but susceptible to pasmo. It is high in percentage of oil and in oil quality.

Others: Crown, Cheyenne, Bison, Buda.

Promising Varieties Under Test

Rocket is a variety having blue blossoms and large brown seeds. Compared with Royal it is slightly earlier, slightly lower in yield and better in oil content and quality. It is resistant to rust and moderately resistant to wilt and pasmo.

RYE

Rye is a vigorous, high-yielding crop in most sections of the Province and is particularly useful on the lighter textured, droughty soils. Fall rye is valuable in the control of annual weeds and for the control of soil erosion.

Dakold 23 is the most suitable variety of **fall rye** on account of its winter hardiness and high yield. The seed is small, wrinkled and mostly greenish in color.

Prolific is the most suitable variety of **spring rye** because of its high yield. The seed is large, fairly smooth and generally green in color.

FIELD PEAS AND BEANS

Special care is required in growing and harvesting these crops. Disease is an important factor and care should be taken to sow only disease free seed.

Dashaway is an early maturing small seeded, good yielding yellow pea. The blossoms are white and the vine has medium length.

Arthur is a medium large yellow pea. It is high yielding and medium late maturing. The blossoms are white and the vine is fairly long.

Early Blue is an early maturing, medium sized high yielding blue pea. It has white blossoms and a very short vine.

Great Northern is a medium-late maturing large white bean of good yield and high quality. It is recommended especially as a market crop.

Norwegian is a very early maturing large brown bean. It is recommended for home use because of its earliness, good yield and high quality.

FORAGE CROPS

Grasses and legumes suited to the rigorous climatic conditions of Saskatchewan are few in number but fortunately they are well adapted and very satisfactory. Drought resistance and winter hardiness are the two qualities which are most essential.

Perennial crops are of great importance in building up and maintaining soil resources. Most perennial grasses add fibre to the soil and have a beneficial effect on soil structure which in most cases assists in preventing wind and water erosion. Similar effects can not be obtained with annual cereal crops. The legumes add nitrogen to the soil and thus improve its fertility. Experiments have shown that in certain districts when grown in rotations, perennial forage crops aid in the control of weeds which are otherwise difficult to control. Recommendations with respect to the use of these crops for soil improvement and weed control will be found in the sections on Soils, Cropping Systems, and Weed Control.

On a large proportion of Saskatchewan farms the limited area in grassland and the rundown condition of the grass is not favorable to a flourishing livestock industry. In many instances the provision for winter feed supply is particularly unsatisfactory. The increasing use of combines in recent years has progressively made this situation more acute. It cannot be too strongly emphasized that unless other dependable supplies are available the growing and building up of hay reserves should be a part of the farm production program. Pasture land in many areas is in an unthrifty and unproductive state. This is due mainly to insufficient acreage for the stock being carried. The reseeding of rundown native or cultivated pastures and the seeding of additional acreages are required on many farms. Land not suitable for cereals may often be suitable for the production of forage crops.

CHARACTERISTICS OF ADAPTED GRASSES AND LEGUMES

Crop characteristics, such as type of root (whether creeping or not), height, leafiness, varieties, etc., are considerations which enter into the choice of a crop or mixture of crops to grow. Table 1 summarizes the main characteristics and suitability for different purposes of the forage crops which can be grown successfully in Saskatchewan.

Varieties

Crested Wheat Grass.—Fairway is leafier and finer stemmed and although equal in yield it is two to three inches shorter than Common. Under drought Fairway ripens off or becomes dormant more quickly than Common. For use as a hay crop the taller growth of the Common makes it easier to harvest.

Brome.—Common or Superior are recommended. **Parkland,** while considerably more leafy and less strongly creeping, is lower in hay and seed yield.

Alfalfa.—Ladak is more drought resistant, more winter hardy and higher yielding than Grimm throughout Saskatchewan. In addition it has some resistance to bacterial wilt which Grimm lacks. Outside the Grimm seed growing area it is recommended that **Ladak** be used whenever seed can be obtained. Grimm, however, is a very satisfactory variety if Ladak is not obtainable.

Sweet Clover.—Arctic, Alpha, and Common White are all white blossomed. Arctic is finer stemmed and more uniform than Common. Alpha is very fine stemmed and leafy but grows only

Crested wheat grass alfalfa mixture on left and crested wheat alone on right. Sown 1937, photographed August 1, 1939, after having been cut twice. Over a period of years the mixture yielded twice as much as the grass alone.

TABLE 1

CHARACTERISTICS OF ADAPTED BIENNIAL AND PERENNIAL GRASSES AND LEGUMES

Crop	Characteristics	Suitability		
		Pasture Crop	Hay Crop	Other Purposes
Crested Wheat Grass	Long lived perennial with very extensive and very tough fibrous roots which are resistant to decay. No creeping roots. Fairly leafy, medium tall growing.	Ideal in early spring, relatively unproductive during summer, good in fall if moisture available.	Good, but should be cut as soon as fully headed.	Ideal for restoring fibre to the soil. Excellent seed producer. Not effective as a sawfly trap, nor is it a source of danger.
Brome Grass	Long lived perennial which tends to become sod-bound 4 to 5 years after seeding. Strongly creeping roots and very extensive fibrous root system. Very leafy, tall growing.	Good spring and fair summer pasture.	Good; for best value should be cut at or before flowering stage.	Good for restoring fibre to the soil. Valuable as sawfly trap crop. (See insect section). Good seed producer.
Western Rye (Slender Wheat Grass)	Short lived perennial living only 4 to 5 years. Comparatively small fibrous root system which decays rapidly. No creeping roots. Fairly leafy, tall growing.	Fair spring and summer pasture.	Good hay crop but must be cut by flowering stage at latest.	Very little value for adding fibre to the soil. Good seed producer. Dangerous as breeding ground for wheat stem sawfly. Valuable on alkali and spring flooded land.
Timothy	Fairly short lived perennial. Without creeping roots. Fairly leafy, tall growing.	Good spring and summer pasture in northern districts for low wet areas.	Good in northern areas and under wet conditions. Must be cut by flowering stage at the latest.	Of very little value for adding fibre to soil. Under moist conditions, good seed producer.
Reed Canary Grass	Long lived perennial. Large creeping root system. Fairly leafy, very tall. Stems tend to be coarse.	Satisfactory for areas subject to flooding.	Useful on low wet areas. Tends to be coarse. Should be cut just as heading begins. 2nd cut better quality.	Fair seed yielder, but seed shatters very easily and is hard to collect.
Alfalfa.	Long lived perennial. Generally winter hardy but occasionally kills especially if cut or closely grazed in fall. Tap root. Very leafy, leaves readily lost in curing. Tall growing.	Excellent high protein feed but danger of bloating exists. Should not be closely grazed in fall.	Excellent, high protein. Cut when about 10% of crop is in flower. Avoid excessive handling of cured hay. Allow it to make at least 6 inches of growth by freeze up.	Valuable for building up soil nitrogen. Good seed yields are obtained in relatively few districts.
Sweet Clover	Biennial (lives only 2 years). Tap root. Leafy; and leaves readily lost in curing. Very tall growing. Tends to be coarse stemmed under moist conditions.	Excellent high protein feed but some danger from bloating. Stock soon acquire a liking for it.	Excellent if cut before it becomes too coarse. Cut as it comes into bloom. Moldy or poorly cured hay is dangerous to feed.	Valuable for adding nitrogen to soils. Useful for alkali areas. Very good seed yielder.
Alsike Clover	Fairly long lived perennial. Not completely winter hardy and may kill in exposed locations. Tap root. Fairly leafy. Fairly short growing.	Suitable in mixture with grasses on alkali-free areas subject to flooding.	Suitable in mixtures with grasses on alkali free areas subject to flooding.	Good seed producer under good moisture conditions in northern areas.
Red Clover	Short lived perennial (often used as biennial) Not completely winter hardy.	Fairly suitable in mixture with grasses under favourable moisture conditions.	Useful in mixture with grasses under favourable moisture conditions.	Good seed producer under good moisture conditions in northern areas.

Grasses during periods of rapid growth are likely to taint milk. See section on Pastures and Pasture Management.

For information on insect pests and diseases, see sections dealing with these subjects.

about two-thirds the height of Arctic. Aura, Erector and Redfield Yellow are yellow flowered types. Aura and Erector are early flowering and more erect growing than Common Yellow and yield well. Redfield Yellow is about three to four weeks later in starting flowering than the other varieties, it yields well and, although tall growing, is not very coarse.

Red Clover.—Altaswede and Manhardy are the most winter hardy of present varieties. They are single cut types and short lived perennials.

RECOMMENDED GRASSES, LEGUMES AND MIXTURES

Adaptation to climatic and soil conditions is a very important factor in selecting the crop or mixture of crops to grow. The crops and mixtures adapted to the varying soil and climatic conditions encountered in the Province are given in Tables 2 and 3. The map shown on page 9 is the basis of the major soil zones referred to in these tables.

Wherever possible it is advisable to grow a grass-legume mixture. Alfalfa is the legume most generally used in mixtures, although sweet clover and alsike clover may be used under certain conditions. Compared to grass sown alone a grass-legume mixture produces a better balanced feed and is higher yielding over a period of years. In the more moist sections of the dark brown soil and in the black, degraded black and grey soil zones grasses sown alone become sod-bound and yields drop sharply in stands three to five years old. In contrast, grass-alfalfa mixtures do not become sod-bound as long as the alfalfa remains in the mixture. Grass-alfalfa mixtures will yield from two to four times as much as grasses sown alone when such becomes sod-bound. In the brown and drier parts of the dark brown soil zone the difference in yield between grass and grass-alfalfa is less pronounced, but is still sufficient to warrant using the mixture. Compared to the legume grown alone the grass-legume mixture cut for hay is more easily cured and there is less chance of losing the legume leaves. When utilized for pasture there is less danger of bloating on the grass-legume mixture than on the legume alone.

SEEDING PRACTICES

A good stand is of the utmost importance. Biennial and perennial forage crops have small seeds and the seedlings are small and delicate. More care is needed, therefore, in seeding forage crops than in seeding grain crops.

Choice and Preparation of Seed.—In purchasing forage crop seeds there is a danger of introducing serious noxious weeds. The best means of avoiding this menace is to use field inspected (Registered or Certified) Grade No. 1 seed.

Aside from cleaning to remove weed seeds, pieces of stem, leaves, etc., grass seed does not require any special preparation for seeding. Seed of the legume crops, however, require further attention.

Sweet clover seed should be well scarified. When purchased from a seed house, the seed is already scarified. Home grown seed may be scarified by running it through a feed grinder with the plates set just far enough apart so as not to grind more than a small proportion of the seed. At least 80 percent of the seed should be scarified. The proportion of scarified seed in a sample can be determined by placing a small quantity in water. In 24 hours the scarified seed will swell to at least twice the normal size. Alfalfa, red clover and alsike clover seed do not require scarification.

Sweet clover, alfalfa, alsike clover and red clover seed should always be inoculated with bacteria culture just before seeding. Such inoculated seed should not be mixed with wheat or other grains that have been treated with Ceresan, Arasan or similar products for the control of smut. Bacterial culture for inoculating seed is available from seed companies and directions for applying it are provided on the bottle or container. The crop for which the inoculum is required should be stated when ordering. Bacterial culture should not be used after the date of expiration given on the package.

Condition of the Seed Bed.—If the seed is to be drilled in, it is absolutely essential that the land be firm enough to permit shallow seeding. Summerfallow and recently plowed or cultivated land should be packed before seeding. Packing is effective only when the soil is moist, therefore this operation must be done in the very early spring on summerfallow or immediately after

TABLE 2

RECOMMENDED GRASSES AND LEGUMES AND MIXTURES FOR WELL DRAINED UPLAND SOILS WITHIN THE MAJOR SOIL ZONES.

Soil Texture	Recommended Crops or Mixtures	Seeding rate in pounds per acre for seeding in drills 6" apart unless otherwise stated		
		For Hay	For Pasture	For Seed Production
Brown Soil				
Loams and Clays	Crested Wheat Alfalfa	5–6 2 (rows 12" apart)	10 1	
	Brome Alfalfa	6 2 (rows 12" apart)	12 1	
	Crested Wheat Brome Alfalfa	4 2 (rows 12" apart) 2	6 4 1	
	Alfalfa	5–6 (rows 12" apart)		2–3 (rows 36"-42" apart
	Crested Wheat		10	2–3 (rows 36"-42" apart
	Brome		14	
Light Loams and Sandy Soils	Crested Wheat	5–6 (rows 12" apart)	10	2–3 (rows 36"-42" apart
	Crested Wheat Alfalfa	5–6 2 (rows 12" apart)	—	
Dark Brown Soil				
All Textures	Crested Wheat Alfalfa	5 2	5 2 (rows 12" apart)	
	Crested Wheat Brome Alfalfa	3 5 2	3 5 2	
	Brome Alfalfa	10 2	10 2	
	Alfalfa	5 (rows 12" apart)		2–3 (rows 36" apart)
	Brome	10	10	10
	Crested Wheat	5 (rows 12" apart)	5 (rows 12" apart)	5 (rows 12" apart)
	Sweet Clover	12	12	12 (rows 12" apart)
Black, Degraded Black and Grey Soil				
All Textures	Brome Alfalfa	10 2	10 2	
	Brome Crested Wheat Alfalfa	6 4 2	6 4 2	
	Alfalfa	7		5
	Brome	10	10	10
	Crested Wheat Alfalfa	7 2	7 2	
	Western Rye Alfalfa	8 2	8 2	
	Western Rye	8	8	8
	Crested Wheat	7	7	5 (rows 12" apart)
	Sweet Clover	12	12	15
	Timothy Alfalfa	6 2	6 2	
	Timothy	6	6	6
	Red Clover			5
	Alsike Clover			4

TABLE 3

RECOMMENDED GRASSES AND LEGUMES AND MIXTURES FOR POORLY DRAINED AREAS SUBJECT TO FLOODING

Soil Zone	Soil Condition	Maximum Duration of Spring Flooding	Recommended Crops or Mixtures of Crops	Rate of Seeding Lbs. per acre
Brown, dark brown and black soils.	Sloughs and alluvial flats reasonably free from alkali.	Up to 2 weeks	Mixtures of: Brome	5
			Western Rye	4
			Crested Wheat	4
			Alfalfa	1
		10 days to 3 weeks	Mixtures of: Western Rye	4
			Brome	4
			Timothy	2
			Alsike	1
		4 to 7 weeks	Mixtures of: Timothy	4
			Reed Canary	4
		7 weeks or longer	Reed Canary alone	4 to 5
	Slight to moderate alkali.	Up to 10 days	Mixtures of: Brome	4
			Western Rye	4
			Crested Wheat	3
			Alfalfa	2
			Sweet Clover	5
		10 to 28 days	Mixtures of: Brome	8
			Western Rye	10
			Alfalfa	2
Black, degraded black and grey soils.	Meadows, sloughs, and peat soils reasonably free from alkali.	10 to 14 days	Mixtures of: Brome	10
			Timothy	4
			Alfalfa	2
			Alsike	1
		10 to 28 days	Mixtures of: Brome	10
			Timothy	4
			Alsike	2
		Over 28 days	Mixtures of: Timothy	4
			Reed Canary	4

plowing or other cultivation. Stubble land is usually firm enough. It is also essential that all danger of soil drifting be eliminated. Where soil drifting is a menace, seeding should be done into stubble, or into a covering of trash or dead weeds, without using any cultural operation previous to seeding.

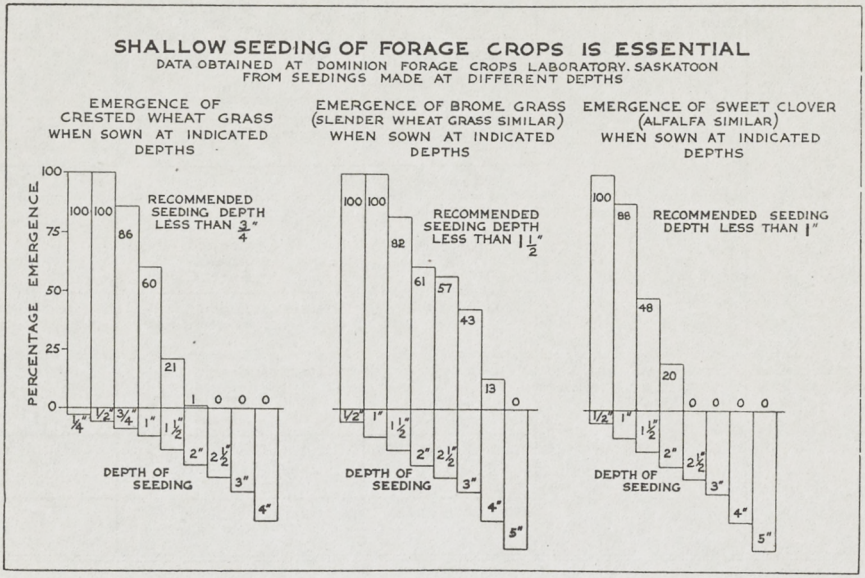
Time of Seeding.—Since shallow seeding is necessary, it is essential that seeding be done when there is moisture in the soil to within a fraction of an inch of the surface. This condition is usually found in the very early spring or in the fall.

Spring Seeding.—It is strongly recommended that spring seeding be done as soon as it is possible to get on the land. This practice is particularly important in the brown and dark brown soil zones and on the light loams and sandy soils of all zones. In the more moist areas, seeding may be delayed as late as June with reasonable chance of success.

With alfalfa and sweet clover, in years and areas where cutworms are a severe pest, it may be advisable to delay seeding until early June, as these pests are very fond of the seedlings. In northern areas where the danger of late spring frosts exists seeding of legumes should be delayed.

Fall Seeding—Seeding in the fall in the brown and dark brown soil zones and drier parts of the black soil zones has proven consistently more successful than early spring seeding. This is particularly the case on the light loam and sandy soils in these zones. Elsewhere in the Province there is generally no particular advantage from fall seeding. Fall seeding may be done in late August or early September if moisture conditions are good or just prior to freeze-up (third or fourth week in October). At either period seeding should be done only into stubble or a dead weed or trash cover and not on summerfallow or fall plowing. Brome grass, crested wheat grass, slender wheat grass, and reed canary grass may be seeded at either period in the fall. When seeding alfalfa in the fall it should only be done just prior to freeze-up. Sweet clover should only be spring sown. Information is lacking on the success of fall seeding of other grasses and legumes.

Under conditions of moderate to heavy grasshopper infestation, grasses or legumes seeded in the early fall or late spring on stubble are in danger of being eaten by the insects and destroyed in the seedling stage. A safer procedure is to seed early in the spring on summerfallowed land which is located at some distance from stubble fields where the grasshopper eggs have been laid. By so doing the forage crop will get an early start and the young plants may become strong enough to survive if attacked later in the season.



Shallow Seeding.—Shallow seeding of grass and legume seeds is an absolutely essential practice if satisfactory stands are to be obtained. Deep seeding has probably resulted in more failures than any other single factor. With the exception of brome and slender wheat grass the seed of all grasses and legumes should be sown less than one inch deep. Brome and slender wheat grass should be sown not deeper than 1¼ to 1½ inches. When using a grain drill it is possible to obtain this shallow seeding only when the land is firm and there is practically no pressure on the discs. The importance of a firm seed bed cannot be overemphasized.

Broadcast Seeding.—Seed that is broadcast must be covered by light single discing or harrowing. Packing after discing or harrowing is a desirable practice. While drilling the seed into the ground is preferable to broadcasting, certain crops, such as timothy, red top, reed canary grass, and alsike clover have such small seeds that it is generally impractical to seed them with an ordinary grain drill. Other crops, such as alfalfa and sweet clover, are frequently broadcast. A Cyclone seeder is a valuable aid when broadcasting. A grass seed or fertilizer attachment on a grain drill may be used to broadcast the seed.

Seeding With a Grain Drill

(a) **Without a Nurse Crop.**—A grass seeder attachment is valuable in seeding the small seeded crops but it is not essential. Well cleaned seed of crested wheat grass will feed from the drill box at about eight pounds per acre with the drill set to sow about 1½ pecks of wheat. In a similar way, a setting of about three pecks of wheat will seed slender wheat grass at eight pounds per acre. Brome grass is very difficult to seed alone; the drill has to be opened up to about 10 to 12 pecks of wheat. New drills and those with a forced feed will seed alfalfa and sweet clover at a desired rate but old drills usually sow these crops much too heavily unless the seed is mixed with bulky material. If the grass seed is well cleaned and reasonably plump a mixture of eight pounds of brome and one to two pounds of alfalfa or five pounds of brome, three pounds of crested wheat grass and one

or two pounds of alfalfa may be sown with a force feed type of drill by setting it to sow 35 pounds of wheat. In all cases the setting of the drill will vary, depending on the condition of the drill and the quality of the seed.

With brome grass, sweet clover, alfalfa and all other crops having small or light seeds it is desirable to mix the seed with cracked grain in the proportion of about one pound of grass or legume seed to three pounds of cracked grain.

To determine whether the drill is set correctly weigh out two or three lots of seed of the amount to be sown per acre. Put one lot in the drill box, but before doing so fill the cups level full. When the seed has been used down to the level of the top of the cups, one acre should have been sown. The acreage actually sown can be checked on the drill tally or can be calculated from the drill width, the length of strip sown and the fact that there are 43,560 square feet in an acre. By testing the drill setting in this way two or three times and making adjustments, the desired rate can be obtained.

(b) **With a Nurse Crop.**—Particularly in the brown and dark brown soil zones, and the drier parts of the black soil zone, seeding without a nurse crop gives greater assurance of a good catch. The forage crop cannot compete for moisture successfully with the faster growing cereal crop and for this reason the former frequently dies or is so weakened that normal growth is not attained. In the more moist areas of the Province, good stands are obtained most years when seeding is done with a nurse crop.

As nurse crops the cereals rank in preference as follows: flax, wheat, oats, barley. The nurse crop should be sown at not more than one-half to two-thirds the regular rate and should be cut as early as possible, preferably for hay or green feed. When seeding with a nurse crop, every precaution must be taken to avoid seeding the forage crop too deeply.

Forage crop seed may be mixed with grain in the proper proportion, or fed separately into the drill spouts by means of a grass seeder attachment. However, shallow seeding of the forage crop is essential and the cereal therefore must be sown at less than one inch in depth by this method. Unless it is used only to broadcast the seed, a grass seeder attachment is no aid in avoiding overdeep seeding. If it is desired to seed the nurse crop at the usual depth, it may be sown alone, and then the forage seed sown crosswise at the necessary depth. This is a good practice but requires more work. The forage crop may, of course, be sown broadcast and the nurse crop sown in the usual way.

IMPROVING SLOUGHS AND MEADOWS

In almost all sections of the Province there are local areas of low-lying land subject to flooding for varying periods. Such land varies from slough bottoms to meadows and peat land. Frequently the soil in these areas contains alkali salts. Some such areas have been broken up and are being used for grain, whereas they might be more profitably used for hay or pasture. On the extensive acreages of such land which have not been broken, the yield and feeding value of the native grass can be much improved by seeding to cultivated grasses and legumes.

Suitable grasses and legumes and mixtures for many of the varying conditions of flooding, salinity, etc., encountered on these low-lying areas, are given in Table 3. For locations where there is considerable variation it is recommended that the more complex mixtures be used. It may be advisable to break a strip through such an area and seed it to a mixture including several grasses and legumes. Observations on such a strip will often give a valuable indication as to the kind of forage crop or crops which will do well over the whole slough or meadow.

As a preparation for seeding areas which are in native grass, the land, if possible, should be plowed and worked down. Where stoniness, general roughness or other conditions make plowing impossible or impractical, heavy discing or one-waying of the land is recommended. The procedures recommended in the section on Seeding Practices should be followed. On very heavy soils crusting may develop and prevent the seedlings from emerging. On such soils broadcasting the seed and covering it very lightly is the most effective means of securing a stand.

Peaty soils require special attention. Surface drainage is the first requirement in bringing these soils under cultivation. Heavy pasturing for a few years prior to breaking is beneficial as packing and manuring is accomplished by the grazing animals. After breaking and before seeding the peat should be heavily packed.

In the black, degraded black and grey soil zones sloughs used for hay frequently become polluted with dandelions. Spraying with 2,4-D (see Weed Section) should eliminate the dandelions and restore the productivity of the grass.

HAY AND HAYMAKING

The time of cutting and manner of handling are important factors affecting the quality of hay. The tendency is to cut hay too late. The following table gives the approximate protein and phosphorus content of grasses harvested at various stages. The figures are based upon a large number of analyses made and reported by the Dominion Experimental Station at Swift Current. While different grasses differ in composition the stage of maturity has a far greater effect than the kind of grass.

Time of cutting	Approximate Date	Approximate chemical composition in percent	
		Protein	Phosphorus
Early Heading	Mid June	14.00	0.20
Flowering	Late June, early July	11.00	0.18
Medium Seed	Mid July	7.00	0.13
Late Fall	Early October	4.50	0.08

In Saskatchewan in general, winter feed supplies are deficient in protein and phosphorus. A phosphorus content of 0.13 or less in hay is considered definitely insufficient for animal requirements. From these facts the importance of cutting hay early should be obvious. Indications are that at the flowering stage approximately the maximum yields are obtained.

The recommended stage at which to cut the various cultivated grasses and legumes is given for each crop under the column "Suitability for Hay" in the table on page 44. Feeding value declines rapidly after the recommended stages of cutting are reached. Prairie wool and slough hays should be cut the end of June or early July for maximum quality and feeding value. Slough hay cut late in the fall is little, if any, better than cereal straw.

Prolonged exposure to dew, rain or sun during the curing process reduces the feed value. Since the leaves are the most valuable part of the plants, the curing and handling should be designed to prevent their loss. This is particularly important in the legumes (alfalfa, sweet clover, etc.). If legume crops are cut with the mower they should be raked into windrows within a few hours after cutting at the latest and, if the hay is to be bunched, this should be done before the hay is dry.

Thorough and uniform drying of a hay is very important, particularly if it is to be barn stored. Spontaneous combustion occurs only when hay is incompletely dried before stacking. The danger of fire from this cause is greatest in legume hays. If hay is of doubtful keeping quality, it should be stacked outside in narrow stacks and not stored in the barn.

Sweet clover hay which is spoiled or becomes moldy or musty during curing is likely to reduce the clotting power of the blood of animals that it is fed to in any quantity. If known or suspected of being moldy it should be fed in limited quantity and should not be fed at all a few weeks prior to an operation or giving birth to young.

Stacks should be built on high, dry ground and, if they are to stand for some time, should be built as high as possible. Stackers of various types are helpful in building tall stacks.

Speed in the haying operations is a factor in escaping weathering damage. Suitable equipment is a great aid in speeding up the work and also in reducing the hand labor involved. A pea harvesting attachment which windrows hay as it is cut, hay loaders, hay sweeps of various types, and stackers of various designs, may all be made or purchased. Further information on these may be obtained from your Agricultural Representative, the Dominion Experimental Stations or the University of Saskatchewan.

PASTURES AND PASTURE MANAGEMENT

Pastures, either native or cultivated, maintained in a thrifty condition, provide the most economical and best summer feed for livestock. On many Saskatchewan farms the pasture land is badly run down and far below maximum productivity. The principal factor responsible for this depleted condition is over-stocking.

Effects of Over-Stocking.—Pastures which are kept eaten down gradually become less productive and less palatable, and weeds increase at the expense of the desirable forage plants. This trend is slow at first and often escapes notice, but with continued over-grazing the weeds increase until they are more abundant than the grass. The common plant indicators of over-grazing include pasture sage, cactus, golden aster, brown weed and yarrow. As the supply of the best forage plants becomes depleted, less palatable and less nutritious vegetation is eaten. Likewise, if poisonous plants are present, greater quantities may be eaten, resulting in heavier livestock losses. A pasture in a depleted condition does not produce the expected yields of beef, milk and other animal products. Soil erosion increases with over-stocking. Grasshoppers find over-grazed fields excellent egg-beds.

Proper Management Practices.—One of the most important means of maintaining the productivity of pasture and range land is to provide sufficient acreage of grassland so that at the end of the grazing season there is some of the current year's growth left. This ensures that the grass will be maintained in a vigorous condition and allows some of the grass to set seed. This carryover of cured grass is valuable for use along with the new growth of the following spring. Heavy grazing early in the spring is particularly injurious to pasture grasses, hence moderate use at that time is most important.

Uniformity of grazing over the entire pasture is also important. Proper distribution of water, salt licks, and shelter insures better use of pasture. Stock which has to travel more than 1½ miles to water usually over-graze the area adjacent to the water and under-graze the more distant portions of the pasture.

Better pasture management is sometimes secured by dividing the grazing area into smaller units and rotating the stock by seasons from one unit to another. Applications of barnyard manure at 5 to 15 tons per acre has been found to increase the productivity of grass to a marked extent.

Where the acreage of native grassland or cultivated grasses is below that required to provide for a carryover of grass from one season to the next, sufficient additional land should be seeded to cultivated grasses to provide adequate acreage.

Crested wheat grass is the first grass ready for spring grazing; it can be lightly pastured as soon as it commences growth, and heavy grazing can be practised in May and June. Native grass pasture is seldom ready before mid-May and needs to be protected or lightly grazed prior to that date. Summer pastures of native grasses, brome and annuals are preferred to crested wheat grass. Crested wheat grass is often productive again in the fall.

The period of critical pasture shortage on most farms is in July and August. If the acreage of native and cultivated pasture land is insufficient to provide for this period without over-grazing, the use of an annual crop, such as oats or rye, is highly desirable. The section on Annual Hay and Pasture Crops on page 55 gives information on the use of these crops.

Restoration of Depleted Pastures.—Pastures which are only slightly depleted may generally be brought back to maximum productivity by the application of proper grazing practices as outlined above. A system of rotational grazing is particularly valuable in this connection. Badly depleted pastures, however, should be re-seeded to cultivated grasses. The recommended grass or mixture for the soil and climatic condition existing in the area to be re-seeded may be found in Tables 2 and 3. The information contained in the section on "Improving the Grass in Sloughs and Meadows" may also be helpful.

Most of the methods recommended in the section on "Seeding Practices" apply to the seeding of depleted pastures. As a preparation for seeding on the heavier soil types, it is recommended that the land be double disced, but on sandy soils cultivation prior to seeding is not advisable. It is desirable to drill the seed in, but on land which is too rough or stony it may be broadcast. Particular care should be taken to avoid grazing the young plants on re-seeded areas in their first year of growth.

Bloating on Legume Pastures.—Bloating is most likely to occur when animals are permitted to pasture a legume which is wet with dew or rain and if the legume is grown alone or a mixture of a grass and legume is cut for hay when the second growth is pastured. The practices which aid in the prevention of bloating are:

1. Avoiding pasturing as far as possible when the pasture is wet.

2. Allowing the stock to become gradually accustomed to the legume by turning them into the pasture when their appetites have been fairly well satisfied and gradually increasing the daily period on such pasture.

3. By providing the stock with some dry feed, such as straw.

Care of Alfalfa Pastures or Pastures Containing Alfalfa.—Alfalfa fields which are pastured closely in the fall are liable to winter kill. Therefore, on pastures composed of or containing alfalfa, grazing should be reduced or discontinued from August onward to permit the alfalfa to attain a height of about six inches by freeze-up.

Milk Taints from Grass Pasture.—During periods of rapid growth most grasses will taint milk to some extent but crested wheat grass is somewhat worse than others in this respect. The undesirable odor may be reduced by removing the cattle from the pasture some time prior to milking. The length of time required varies but in severe cases three hours is considered sufficient.

GENERAL MANAGEMENT OF GRASSES AND LEGUMES

Rejuvenation of Old Stands. — The yield of all perennial grasses and legumes tends to become less after the first three or four years. Therefore new fields should be sown from time to time and old ones broken up. Where it is not practical to do this, the crop may be revived temporarily by cultivation, re-seeding, manuring or fertilizing, or a combination of these.

Brome grass which has become sod-bound may be rejuvenated by:

(a) Shallow plowing, one-way discing, double discing, or cultivating with a narrow tooth cultivator in the spring. These treatments may result in severe killing of the grass under dry conditions.

(b) Applying barnyard manure, preferably well rotted, in the fall or winter, at the rate of 12 to 15 tons per acre.

Growing the brome grass in a mixture with alfalfa prevents the sod-bound condition from developing.

Brome stands which have become thin may be disced and then seeded to crested wheat grass.

Crested wheat grass which has become too thick can be thinned by discing or cultivating. The cultivation should not be too severe as the grass is easily killed.

Alfalfa which has thinned out may be disced or cultivated and seeded to brome grass or crested wheat grass or, in northern locations, to timothy. Native grass pastures which have thinned out may be seeded to crested wheat or brome grass.

Control of Sweet Clover.—Because of its hard seed coat, sweet clover seed may live in the soil many years before germinating. The crop thus tends to volunteer and, if volunteer plants occur in wheat fields, the wheat may be degraded because of sweet clover odor. To avoid or reduce the danger of this occurring, the following practices are recommended:

(1) Use only well scarified seed.

(2) Seed shallow and early.

(3) In order to prevent seed formation do not permit the sweet clover to make a second growth after cutting for hay.

(4) Avoid seeding wheat on fields known to be polluted with volunteer sweet clover.

(5) After removing a crop of seed, cultivate immediately at a shallow depth and summerfallow the next year.

Sweet clover can be eliminated from grain fields by spraying with 2,4-D.

Snow Plowing.—Outside of the chinook area of the Province, the hay yield of grasses and legumes has been increased by at least 40 to 50 percent by snow plowing. The grasses and legumes respond to such treatment to a far greater extent than the cereals. The use of the snow plow on hay or pasture land is strongly recommended. The snow plow can be constructed at home at small cost. For further information write to your nearest Experimental Station or to the University of Saskatchewan.

Breaking Up Grassland.—The following factors should be taken into consideration in deciding when to break up a stand of grass:

(1) In general there is a drop in productivity three or four years after seeding.

(2) A substantial amount of root fibre has been restored in three to five years. Three-year-old stands of either brome or crested wheat will have built up about 2.5 tons and five-year-old stands about three tons of root fibre per acre to a depth of one foot in the soil. In comparison it has been found that good native prairie will have about six tons of root fibre per acre foot.

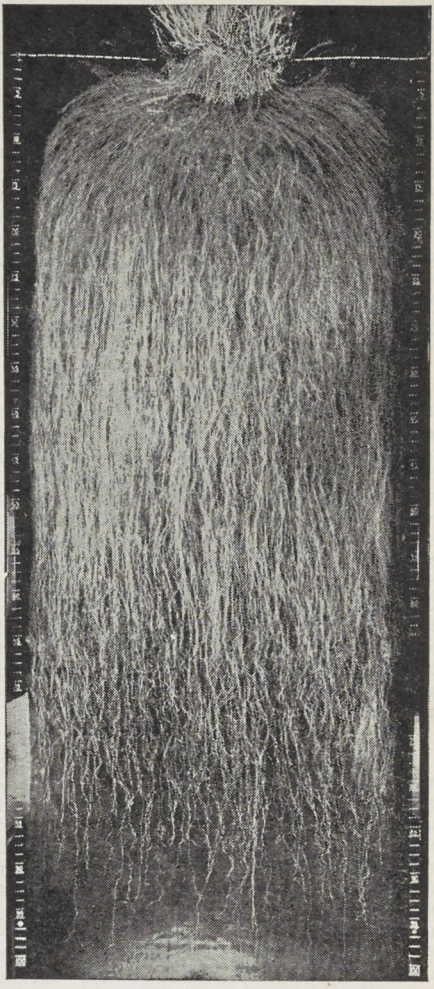
(3) Severe wireworm infestation usually develops in fields cropped to grasses for four or more years in succession.

In view of these considerations, it is recommended that, where the grassland enters into a rotation, it should be re-broken within four years of the last time it was in summerfallow. The danger of wireworm infestation should be considered in selecting a crop to seed on breaking.

In areas where browning rootrot and take-all diseases are troublesome, it is advisable to sow flax as the first crop after breaking up the grass sod. As land down to grass for several years is reasonably free from weeds, flax crops may be grown successfully. If a grain crop must be grown, oats will probably do best.

In breaking up grassland in the black and grey soil zones, breaking should not be done later than late June or early July. In the brown and dark brown soil zones breaking should be done in May if possible and summerfallowing practised for the remainder of the year.

Because of its creeping roots, brome grass is somewhat difficult to eradicate under favorable moisture conditions. The best procedure is to plow shallow after harvesting for hay or pasturing until about July 1st; then cultivate as frequently as is necessary to keep down all green growth; and finally, backset at a greater depth in the late fall.



The root system of a single three-year-old plant of crested wheat grass showing the depth of penetration and the dense mat of roots near the surface.

SEED PRODUCTION

Successful seed production of some forage crops is possible over a wide area of the Province, while the seed production of other crops is restricted for various reasons to limited districts or conditions. Adaptation of the various crops to seed production in different soil zones and conditions within zones is given in Table 2. Certain information is given also in Table 1. Space limitations prevent the presentation here of more than brief details on the major crops grown for seed.

Fields intended to produce seed should be free or comparatively free of weeds. All sweet clover should be eradicated in and around fields intended to produce alfalfa seed. It is strongly recommended that sweet clover should not be sown under any circumstances or for any purpose in areas where alfalfa seed is a major crop. The seeds of the two crops

can not be separated and alfalfa seed with sweet clover seed in it is heavily penalized in grade. Only fields free of couch grass and darnel should be used for the production of brome grass, crested wheat grass and western rye grass.

In fields intended for seed production only seed of the very highest quality should be used. Information on the production of Certified seed may be obtained from the Plant Products Division, Federal Building, Saskatoon, and on the production of Registered seed from the same office, or the Canadian Seed Growers' Association, Ottawa.

Crested Wheat Grass

This crop is usually ready for harvesting by late July or early August. For swathing or cutting with a binder, the heads should have a slight greenish tinge at time of cutting. The seed then will be firm but not hard. For straight combining it must be left standing longer. The ease with which the seed shatters makes this harvesting method risky. One row of concaves is sufficient to thresh the crop and if it is very dry no concaves are needed and the cylinder speed may be reduced. The wind blast should be reduced to about one-half. Combined seed should be closely watched for heating.

Brome Grass

Brome is usually ready for harvesting in late July or early August. For swathing, or cutting with the binder, the seed should be a brown color and firm, but not hard. Seed to be combined should be more mature. The seed does not shatter readily and may be straight combined. The concaves used and the adjustments of the concaves should be such as to remove the seed completely but not break the stems and leaves more than is necessary. The wind blast should be reduced to about one-half. Combined seed should be closely watched for heating.

Alfalfa

Seed-setting in this crop is primarily dependent on the presence of wild bees to trip and cross-pollinate the flowers. Weather conditions affect the activity of these bees and so influence seed-setting, or the weather may have a direct effect through damage by hail or frost. Soil fertility is a factor also in seed-setting where growth is too poor to produce an abundance of flowers. Injurious insects such as lygus bugs may seriously reduce seed yields.

As a consequence of these factors seed yields are good only in certain districts and certain years. Yields in seed growing districts in the North may be improved by leaving tree growth and undisturbed land around fields to maintain bee populations; early spring burning of stubble and trash to destroy injurious insects and the Fungi causing leaf and stem diseases. Applications of fertilizers containing sulphur at rates of at least 50 pounds per acre are beneficial particularly on sandy and sandy loam soils. Where lygus bugs are abundant they may be controlled by dusting with 3% D.D.T. at 20 pounds per acre applied just before flowering commences.

The crop is ready to harvest from early September onward. It may be cut with a binder and threshed, or swathed and threshed with a combine. If either of these methods is used it may be possible to avoid damage from heavy fall frosts. Straight combining is a general practice also, but it usually is necessary to leave the crop until frost has destroyed all or most of the green growth. The cylinder speed should be increased and the concaves closed up. Combining or threshing when the crop is tough should be avoided.

Sweet Clover

This crop should be cut when about two-thirds of the pods have ripened, which is usually from mid-August to early September. It should be cut with a binder and swathed, but should not be straight combined. The concave adjustment should be such as to leave the pods on most of the seeds, since weed seeds can then be more readily removed. The pods are removed in scarifying the seed.

Red Clover

The single cut varieties of red clover, such as Altaswede and Manhardy, may be grown for seed on the more moist sections of the black soil zone, and in the degraded and grey soil zones. Land well-favored with moisture and having good drainage should be chosen. Rates and kinds of fertilizers as recommended under alfalfa seed production are suitable also for red clover. Red clover must be cross-pollinated by bees before seed will set. Unlike alfalfa, honey bees are very effective and it is recommended that at least one hive of bees be kept for each acre of clover seed.

The crop usually is ready to harvest during the first two weeks of August when most of the heads are dark brown or black in color. Straight combining is favored by some growers, although this method may result in some loss of seed

since the crop must be left standing for some time after it is mature and overripe heads tend to break off. A better method is the use of a mower with a windrowing attachment or a swather followed by a pick-up combine. The seed is difficult to remove from the head. Thus in order to get good separation of the seed the crop must be dry, the concaves set up close, a high cylinder speed maintained and the cylinder not overloaded. The rasp bar type of cylinder is considered more efficient than the plain tooth type.

Alsike Clover

Alsike clover is a heavy seed producer when grown in favored locations in the more moist sections of the black soil zone and in the degraded and grey soil zones. Above normal moisture is essential and, except in wet seasons, the crop will not do well unless seeded where water will collect for one or two weeks in the spring. Fertilization as recommended for alfalfa may be required on light-textured soils. Alsike is an excellent honey crop and seed yields are greatly increased if at least one hive of bees is kept for each acre grown for seed.

The crop is early maturing and should be ready for harvesting early in August. The recommended harvesting method is to cut with a mower having a windrowing attachment, preferably when the crop is tough with dew or rain. The windrows may be picked up with a combine or they may be gathered into bunches and picked up for threshing with the threshing machine. Threshing should be done as soon as the crop is dry. Seed of Alsike threshes out easily but the crop should be dry and the machine should not be overloaded. Because of the ease of shattering the crop should not be handled more often than is necessary and then, whenever possible, when it is tough. Straight combining is likely to result in heavy losses from shattering and is not recommended.

ANNUAL HAY AND PASTURE CROPS

Where moisture is the chief limiting factor in the growth of forage crops, as it is in many parts of Saskatchewan, annual crops must necessarily play an important part in supplying the feed requirements for livestock. Perennial crops have their own sphere of usefulness but annual crops are a more dependable source of forage, one year with another, provided they are grown on land which has sufficient reserve moisture. The relative importance of annual crops for hay or pasture are oats, barley, wheat, spring rye, fall rye, and millet. Oats, barley, wheat and spring rye should be sown reasonably early in the spring if good yields are to be obtained. In at least the brown and dark brown soil zones greater assurance of a crop is obtained by seeding on summerfallow. When utilized as hay, these crops in general should be cut in the dough stage to provide maximum feeding value.

When used for pasture, grazing should not commence until the crop has made five or six inches of growth.

Oats.—Under most conditions oats are superior to the other annual crops for hay. They yield well and give a good quality feed. Oats recover better from grazing and drought than most of the other annuals and therefore yield higher. In addition, oats are higher in protein content.

When used for pasture, grazing should not commence until the crop has made five or six inches of growth.

A mixture of about one bushel each of oats and fall rye sown in the spring provides a productive pasture. If not too heavily grazed in the fall the rye will usually over-winter.

Barley.—The beardless and smooth-awned varieties of barley make good hay, but the rough awned varieties are objectionable. As a pasture crop barley is lower than oats but higher than wheat or spring rye in total yield and protein content. Barley does better in the cool moist sections of the Province.

Wheat.—Wheat makes a good hay if cut before the straw begins to harden. Utilized as pasture it is lower in total yield and protein content than oats or barley. Compared with oats, its use can scarcely be justified except perhaps in the southwestern part of the Province because of its ability to withstand hot winds better than oats.

Spring Rye.—Spring rye is grown in southwestern Saskatchewan as a hay crop and is particularly useful on poor, sandy soils. Its quality is less than that of oats but it is a good winter roughage when cut in the late dough stage. It is a valuable emergency crop.

Fall Rye.—Fall rye is especially suited to the brown soil zone and lighter soil

types in other zones. It is generally a surer crop than other cereals under dry conditions. It produces a good yield of hay and its ability to recover from grazing makes it valuable as a pasture crop. For pasture purposes it may be mixed with oats, as described above. Where pale western cutworms are forecast for the next season, seeding should be done before August 1st or delayed until after September 10th.

Millet.—Millet is a rapid growing short season crop which is very frost susceptible. It cannot be sown until after the danger of spring frost is past. Millets are not good weed competitors and should be sown on clean land. It is particularly valuable for seeding late in the spring after some other crop has failed. Oats make a better feed than millet, particularly for horses, but millet is a satisfactory cattle feed. The foxtail type of millet is superior to the broomcorn or proso types for forage. Siberian is one of the best varieties of the foxtail type. Crown is the best variety of the proso type of millet, being superior in yield and quality of hay, as well as giving high yields of grain. Around 15-20 pounds of seed of the foxtail type and 20-25 pounds of the proso type are required per acre. Millet is very susceptible to the fungus parasite which causes browning rootrot of wheat. It should therefore not be used as a hay crop in districts where this disease of wheat is common.

FODDER CROPS

Corn.—For feeding in the sheaf, fodder corn can be grown successfully in many parts of the Province and provides a valuable feed. The crop may be sown in continuous rows 36 to 42 inches apart with the ordinary grain drill. About 20-30 pounds of seed are required per acre. When a corn planter is available it should be seeded in check rows. This makes it possible to cultivate in two directions and results in better weed control. When seeded in this manner about 8-10 pounds of seed per acre are required.

As soon as there is danger of frost or when the kernels are glazed the crop may be harvested with a corn binder or an ordinary grain binder. When cut with the binder, the sheaves after drying in the field, may be stacked between alternate layers of straw, or fed from the stook. It also may be cut with the mower, left until dry and then stacked between alternate layers of straw.

The recommended varieties for fodder purposes are Falconer, Rainbow Flint, and Northwestern Dent, although Gehu Flint is preferable for areas where early fall frosts are a crop hazard. Hybrid varieties which have been tested so far have been later maturing and no higher in yield than the above standard varieties.

In southern Saskatchewan some corn is grown to maturity and pastured off. For this purpose Saskatchewan White Flint and Gehu are recommended. Where a quantity of seed is required it is a good practice to go over the field before pasturing commences and select a number of mature ears from desirable appearing plants for next year's seed supply.

Sorghum.—Sorghum is not recommended. Amongst other disadvantages it produces hydrocyanic acid when the crop is stunted by drought or injured by frost. This acid is poisonous to livestock. Corn yields higher and does not produce poisonous compounds.

HORTICULTURE

TREE PLANTING

Trees should be used for shelter to a much greater extent than they are at the present time. They are a great aid in gardening: (1) through increasing the amount of moisture from melting snow in the spring; (2) through increasing the efficiency of the moisture present in the soil; (3) through permitting the growing successfully of plants that could not be grown otherwise; and, (4) through permitting the growing of better plants than could be grown without shelter. The use of trees to aid in supplying water for dams and dugouts and in conserving this water is recommended. Rows of trees leading from the dugout and on rising land will trap additional snow that will supply water for the dugout in the spring. Trees planted around the dugout collect snow, reduce the evaporation rate from the water surface and thus conserve the water supply.

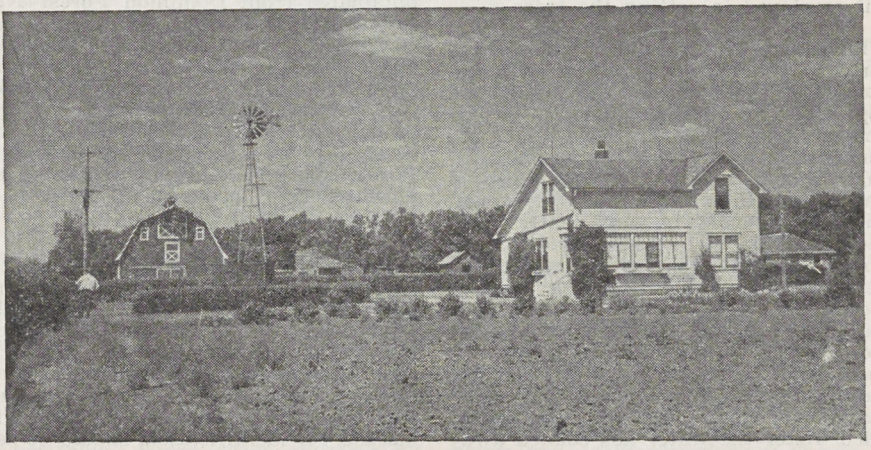
Kinds of Trees to Use.—The rapidly growing kinds recommended for planting in this Province are: Acute-leaf Willow, Laurel-leaf Willow, Siberian Silver Willow, Poplars, Cottonwood and Manitoba Maple (Box-Elder). These kinds do not stand up well under extreme drought conditions and are only short lived on upland prairie soils. They should be used for quick effect and only where moisture conditions are favorable.

The more slowly growing, permanent and drought-resistant kinds are: Green Ash, American Elm and Common Caragana in deciduous trees; and White Spruce, Colorado Blue Spruce, and Scotch Pine in evergreen trees. The Siberian Larch is one of the newer cone-bearing trees that gives promise in tree planting work in this Province.

In the park areas, native trees and shrubs may be transplanted and used in the shelter-belts. Small, rather than large, plants of the kinds selected should be chosen for transplanting.

Willows should be used preferably in soil that is naturally high in moisture because of their fondness for moisture and their lack of drought resistance, and caragana should be used only on well drained soil because of its inability to stand excessive soil moisture.

The selection of at least two kinds of trees for the shelter-belt is desirable as a measure for preventing the destruction of the plantation by pests and diseases. Both rapidly growing trees and slowly growing trees should be used in the main belt to give quick effect and permanency. Kinds either not subject or only slightly subject to attacks by pests



Trees provide shelter and make the home more attractive.

and diseases are preferable to those very subject to such attacks.

Fencing plantations of trees against livestock is of great importance.

Type of Shelter-Belt.—A shelter-belt of standard type is recommended for protecting the buildings, yards and garden areas. This consists of (1) a main belt which is made up of several rows of deciduous trees and (2) a snow-trap which is made up of one or two rows of trees located outside the main belt and with a space of 60 to 75 feet between it and the main belt. In dry areas the main belt should consist of three rows only. One row or more of evergreen trees should be planted at a distance of not less than twenty feet from the inside row of deciduous trees. The sheltered area inside the plantation must be large enough to provide not only accommodation for the garden crops to be grown but also for a cultivated strip, up to 25-30 feet in width, between the inside row of trees and the outside row of garden plants.

Preparation of Soil for Tree-Planting.—Summerfallowing the area to be planted is essential to success in tree planting. This treatment should be given for one year at least prior to planting and in dry sections summerfallowing for two years prior to planting is recommended. A strip up to 16 feet in width, on each side of the area to be occupied by the trees, should be included in the summerfallow and this should be kept cultivated after the trees are planted. Tree planting officials advise against the use of freshly applied manure in the soil employed in setting the trees.

Planting.—The trees should be planted early in the spring before growth begins. The roots of the trees **must** be kept moist at all times and this is particularly true with evergreens, which are very sensitive to drying. Caragana seedlings should not be left standing in water more than a few hours, however. The holes should be sufficiently large and the furrows sufficiently wide to permit the spreading of the roots. The trees should be set an inch or two deeper than they stood previously. The soil should be well firmed around the roots of the trees. Where practicable, a good watering should be given after the roots have been well covered, and before the hole or furrow has been completely filled. After the water has soaked away the operation of filling the hole or furrow is completed, but a slight depression around the plant should be left. The additional soil used to fill the hole should be left loose.

Pruning.—Most small trees used for shelter-belt planting require no pruning at planting time. Caragana seedlings, however, should be cut back to within a few inches of the ground level immediately after being planted. The removal of low branches from older trees being used for shelter is discouraged. Unnecessary pruning in poplars should be avoided.

Conservation of Natural Tree Growth.—The wholesale destruction of trees in the wooded districts has a decidedly adverse effect on crops. It is of great importance, therefore, that bush fires be kept under rigid control and a sizeable acreage on each farm be left in trees.

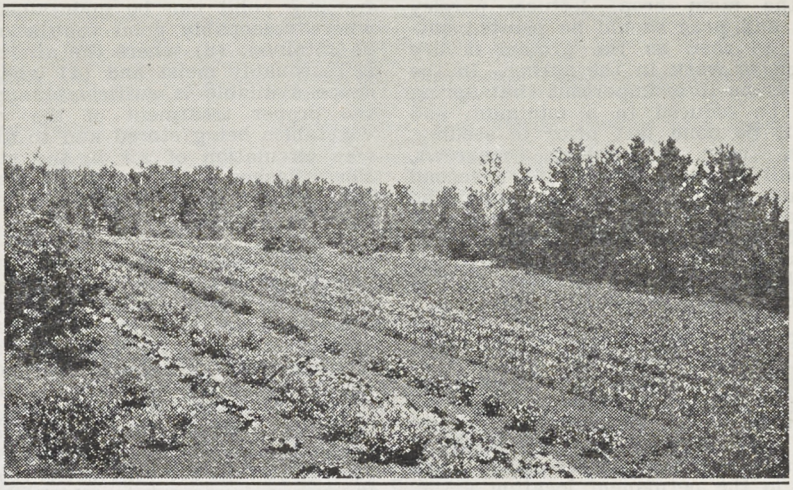
Wood-Lot.—Since the wood-lot is a cheap and convenient source of fuel and fence posts, the preservation of wood-lots on farms in the timbered areas of the Province is recommended. On farms in the park areas the wholesale destruction of trees frequently takes place and the fuel problem in those districts may become acute in the not distant future. The setting aside of an area in timber, up to twenty acres per half section farm, for the sole purpose of supplying fuel and fence-posts in the years to come, is recommended. This area should be fenced against livestock.

Sources of Planting Material.—Trees and cuttings for farm shelter-belts are obtainable from Dominion Forest Nursery Stations located at Indian Head, Sask., and Sutherland, Sask. Seedlings and cuttings of broad-leaf trees are supplied free, while a small charge is made for evergreens. Planters are required to pay transportation charges. Applications for trees should be mailed to Forest Nursery Station, Indian Head, Saskatchewan, preferably one year in advance of planting.

Tree Pests and Diseases.—Information on the control of tree diseases and tree pests is given on pages 90 and 105 of this publication. Specimens of pests attacking trees, for identification, should be sent to Dominion Entomological Laboratory, Indian Head, Saskatchewan and specimens of tree material affected with disease, for identification, should be sent to Dominion Laboratory of Plant Pathology, Saskatoon, Saskatchewan.

VEGETABLE GARDENING

Garden Site.—Important points in choosing a site for the garden area are (1) avoidance of steep slopes because of losses resulting from runoff and erosion; (2) avoidance of areas subject to late frosts in spring and early frosts in late summer and early autumn; (3) presence of shelter, particularly on the north, west and south sides and (4) convenience to dwelling. Likelihood of injury from frosts can be reduced frequently by placing the garden on an area that is somewhat higher than that adjoining, and thus providing better air drainage for the garden plot. The garden should be well fenced.



A Well Protected and Well Planned Garden.

Preparation of Soil.—An area twice the size required to produce the necessary vegetables in a given year should be set aside for the vegetable garden in most sections of this Province. One-half of this should be summerfallowed each year and the other half cropped. An application of well rotted manure should be made previous to summerfallowing. Where moisture conditions are favorable summerfallowing may not be necessary. In such cases plowing in an application of rotted manure in the fall is recommended. In either case an application of twelve to fifteen tons of manure to the acre should be ample. Uniform distribution of the manure is important. Discing the manured area before plowing with a view to improving the distribution of the manure in the soil is recommended.

Importance of Good Seed.—Seed of high quality and of good germinability is desirable. Fresh seeds supplied by seedsmen should be dependable as far as germination is concerned. Seeds carried over from previous years should be given a germination test before being used, in most cases.

Seed Treatments.—Generally speaking vegetable and flower seeds are benefitted by seed treatment. This is most often true when the seeds are planted under unfavorable conditions or when the seed is not of the highest quality. Late plantings of peas and early seeded corn have been found to respond strongly to treatment. Treatment is not recommended for beans. Semesan is an organic mercury treatment which is generally good. Arasan is a non-mercurial disinfectant which is also good. **Caution should be used to avoid over-treatment.** Follow carefully the directions on the container.

Seeding.—Celery, tomatoes, broccoli, leeks, peppers, egg-plants, early cabbages and early cauliflowers should be started indoors. Plants of cabbage and

cauliflower may be set in the garden before the end of May, but those of celery and tomatoes should not be set until all danger of frost is over. Spindling tomato plants should be set considerably deeper than they were in the boxes or pots indoors, or they may be planted in a sloping position in a shallow trench with much of the stem below the ground surface.

Seeds of parsnip, beet, carrot, radish, spinach, chard, cabbage and cauliflower for the main crop; lettuce, parsley onion and peas should be planted outdoors as soon as the ground is dry enough to work in the spring. In the drier areas it is important that spring work be reduced to a minimum and that it be done just prior to seeding. Beans, corn, cucumbers, marrows, pumpkin, squash, melons and a second lot each of beets and carrots should be planted outdoors between May 15th and May 25th in most districts. The second planting of beets and carrots and the main planting of Swede turnips should be made about June 15th.

Asparagus may be started from seed sown early in the spring in a row at one side of the garden and the seedlings transplanted to a permanent row one year later. A quicker method of obtaining a bearing plantation is to purchase one or two-year-old plants and to plant these in the permanent location.

Named varieties of rhubarb must be propagated by division of the clumps and these divisions may be made and planted either in the autumn or early in the spring. These and all other perennial vegetables should be planted together at one side of the garden.

Spacings for Vegetables.—Wider spacings than those usually recommended can frequently be employed to advantage. Weeds are a great enemy of garden crops and these must not be allowed to compete with cultivated plants regardless of spacings. Planting close to trees should be avoided. Where moisture is not abundant, rows of the larger growing vegetables should be at least four feet apart and the plants should stand well apart in the row. **Early thinning should not be neglected.**

Storage of Vegetables.—Every farmer should store certain vegetables in the fresh condition for winter use. Potatoes root crops, cabbages, pumpkins, squashes, marrows and onions are important sources of food for winter use and their storage is recommended.

Two things are essential in the successful storage of fresh vegetables for winter use. These are: (1) a good product in good condition; and (2) good storage conditions. A good vegetable in good condition is one that has been well grown, that is free from insect injuries and diseases that are likely to give rise to trouble in storage and that has been carefully and correctly harvested. Good storage conditions for most vegetables are those (1) where a temperature not more than a few degrees above the freezing point can be maintained; (2) where reasonably good ventilation can be obtained; (3) where the atmosphere is reasonably moist and (4) where the space available is sufficient to permit the proper treatment of the various vegetables being stored and to allow a free circulation of air in the storage. For squashes and pumpkins a temperature around 50°F. with a dry atmosphere is desirable.

Two general types of storage are in use on the farm. One is the house basement and the other, a special underground storage. The former is the more common and can be made satisfactory in most cases. The latter may be used as a storage for roots to be used in feeding livestock in addition to being used as a storage for vegetables. A warm basement will not make a satisfactory storage for vegetables. A corner in such a basement in which there is a window may make a good storage if it is cut off from the main part of the basement by means of a double-wall partition, and if the space between the two walls of the partition is filled with insulating material.

Detailed directions for making a basement storage may be found in a pamphlet issued by and obtainable from the Dominion Experimental Station, Swift Current, Sask. Detailed directions for the storage of vegetables for home use may be found in the Bulletin No. 95—"Vegetable Gardening in Saskatchewan," issued by the Extension Department, University of Saskatchewan, Saskatoon, Sask., and in a pamphlet on the subject obtainable from the Department of Horticulture, University of Saskatchewan, Saskatoon, Sask.

It is a good plan to disinfect the vegetable storage each year. Directions for doing this may be found on page 63.

Varieties.—Variety is recognized as being very important in the successful culture of vegetables. Varieties recommended are as follows:

PERENNIALS:

Asparagus	Mary Washington, Martha Washington.
Rhubarb	MacDonald, Ruby, Sunrise.
Onion	Egyptian, White Welch, Chives.

ANNUALS:

Bean—Wax-podded	Davis White Wax, Round Pod Kidney Wax, Pencil Pod Black Wax.
—Green-podded	Stringless Green Pod, Masterpiece, Refugee, Bountiful, Tendergreen.
—Pole	Oregon Giant, Kentucky Wonder Green Pod, Kentucky Wonder Wax.
Beet	Detroit Dark Red.
Broccoli	Italian Green Sprouting.
Cabbage—Early	Golden Acre, Copenhagen Market.
—Main Crop	Danish Ballhead, Penn State.
Carrot	Scarlet Nantes, Chantenay, Imperator.
Cauliflower	Early Snowball, Early Dwarf Erfurt, Dry Weather.
Celery—Early	White Plume, Golden Plume.
—Main Crop	Golden Self-Blanching, Utah (Salt Lake).
Citron	Red Seeded.
Corn—Early	Golden Gem, Early Golden Sweet, Dorinny, Gill's Early Market.
—Mid-season to Late	Sunshine, Golden Bantam and the hybrids, Marcross, Spancross and Sugar Prince.
Cucumber—Table	Davis Perfect, Early Fortune, Improved Long Green, Straight Eight, Delcrow.
—Pickling	Early Russian, Chicago Pickling, Mincu.
Egg Plant	Extra Early Dwarf, Black Beauty.
Kohl Rabi	Early White Vienna.
Leeks	Champion.
Lettuce—Leaf	Grand Rapids, Simpson's Early Curled.
—Heading	Iceberg, New York No. 12, Sweetheart, Great Lakes.
Marrow	White Bush.
Melon—Musk	Far North, Champlain.
—Water	Sweet Siberian, Early Canada, Sweet Sensation and Northern Sweet.
Onion—For Greens	Multipliers, Dutch Sets, Picklers.
—For Bulbs—Red	Early Flat Red, Red Wethersfield.
—Yellow	Mountain Danvers, Early Grano, Yellow Globe Danvers.
—Transplants	Ailsa Craig, Giant Yellow Prizetaker, Sweet Spanish, Early Yellow Globe.
—Picklers	Early White Barletta, White Portugal.
Parsley	Champion Moss Curled.
Parsnip	Hollow Crown, Guernsey, Short Thick.
Peas—Early	Thomas Laxton, Little Marvel, American Wonder.
—Mid-season	Laxall, Lincoln (Homesteader), Radium.
—Late	Telephone, Stratagem.
Peppers—Sweet	Harris Earliest, King of the North.
—Hot	Hamilton Market.
Potato—Early—White	Warba.
—Pink	Bliss Triumph.
—Main Crop—White	Irish Cobbler.
—Pink	Early Ohio.
—Russet	Netted Gem and Columbia Russet—somewhat late but often do well under irrigation or where the moisture supply is good.
Pumpkin	Sugar.
Radish—Round	Saxa, Crimson Globe.
—Olive-shaped	French Breakfast.
—Long	Icicle.
Spinach	King of Denmark, Long Standing Bloomsdale, New Zealand.
Squash—Summer	Crookneck.
—Winter	Buttercup, Banquet, Green Hubbard and Golden Hubbard.
Swiss Chard	Lucullus.
Tomato—Non-staking, large fruited	Early Chatham, Bounty, N.D.A.C. 38.
—Staking	Earliana, Abel, Bestal, Harkness, Stokesdale, Best of All.
Turnip—Garden	Strap-leafed Purple Top, White Milan.
—Swede	Laurentian.

THE POTATO

The potato is the most important vegetable grown on the farm. Every farmer should produce sufficient of this vegetable to last the household throughout the year.

Varieties.—See Vegetable list above.

Certified Seed Potatoes.—There are three classes of government certified seed potatoes, namely Certified, Certified Foundation "A" and Certified Foundation. These are the only classes that can be sold lawfully as seed potatoes in Canada.

Certified seed potatoes are of a high standard as to purity of variety and are relatively free from disease. These potatoes have been inspected for diseases during the growing season and after digging, and must conform to definite seed standards, both in the field and after harvest. Seed potato

stock of this class is suitable for planting in the farm garden, and for planting by commercial growers producing table stock. A crop from Certified seed is not acceptable for certification, however.

Certified Foundation "A" seed Potatoes are of a higher standard for freedom from diseases than those of the Certified class. Fields planted with Certified Foundation "A" seed are eligible for field inspection and certification.

Certified Foundation seed potatoes are produced by special methods and under strict regulations to insure a high standard of freedom from disease and superiority as to strain. It is very important to use seed stock of this class if one is planning a program of seed potato production.

Government certified potatoes fall into two grades according to size of tuber. These are: Grade A—weighing three to twelve ounces (except for long varieties such as Netted Gem, which allow a range of from three to sixteen ounces). Grade B—one and one-half to three ounces.

Home Seed Selection.—It is good practise to begin with certified seed of a desirable variety and to maintain a well isolated seed plot. This seed plot should be rogued frequently during the growing season, removing all plants showing deformed or otherwise abnormal tops, and the product of the healthy plants kept separate from the main crop. Where it is impractical to maintain a special seed plot, growers are advised to purchase certified seed at frequent intervals.

Seed.—Only seed which is firm, as free from disease as possible and free from frost injury should be used. Where Certified seed is being used tubers of all sizes, including those that are small, are satisfactory. Where seed that is not Certified is to be used, tubers of good size and that are typical of the variety, as to form, should be selected for planting purposes. The presence in the tubers of tunnels made by wire worms does not render the tubers unfit for seed purposes.

Eyes.—These are often used for seed purposes. According to law, eyes must be cut from either Certified or Foundation "A" seed and they are, therefore, a source of sound seed. Owing to the small size of the piece of tuber supplied with the eye, eyes are less satisfactory than standard one and one-half ounce or two ounce sets.

Treatment of Seed Prior to Planting.—The treatment of seed potatoes prior to planting is generally regarded as good practice. Either corrosive sublimate at the strength of one ounce to eight imperial gallons of water and the potatoes submerged for two hours or Semesan Bel at the strength of one pound to six gallons of water and the potatoes submerged for two minutes may be employed. Where corrosive sublimate is used, the treatment must be given before cutting. Where Semesan Bel is used the treatment may be given either before or after cutting, preferably after cutting. Where corrosive sublimate is employed, the containers used must be non-metal. Aluminum containers should not be employed for use with Semesan Bel. **Directions should be followed carefully and overtreatment avoided. Both chemicals are highly poisonous and great care should be exercised in handling them. Seed treated after cutting should be planted promptly.**

Preparation of Seed.—Seed potatoes, that have been stored where the temperature remains low in the spring and where the breaking of dormancy is likely to be retarded, should be transferred from the storage to a moderately warm room three to four weeks before planting time.

For early potatoes, the grower may place a number of medium-size whole tubers in a shallow tray, seed-end up, near a window a few weeks before planting time. These tubers will produce short, thick, green sprouts. These tubers may be planted whole or sets may be made from them and planted at once. The planting should be at a depth of about four inches and it should be done during the first or second week in May, depending upon the season. The sets or tubers should be placed with their sprouts upward.

Tubers, to produce the main crop, may be cut into sets for planting or planted whole. Common practice is to plant the smaller potatoes whole and to cut the larger potatoes into one and one-half to two ounce sets. Each set should have from two to three eyes. Any tuber showing internal discoloration should be discarded. After cutting such a tuber, the blade of the knife used should be dipped in a solution of formalin at a strength of two teaspoonfuls of standard formalin in a quart of water or in a five percent solution

of lysol (three teaspoonfuls in a cupful of water). Cut sets should be planted soon after cutting and should not be left in a close pile even over night.

The Potato Area and Its Preparation.—Rotation and avoiding the growing of the crop on the same area oftener than once in five or six years is recommended for the potato. An area in which the soil is naturally moist but which has good surface drainage and good air drainage is desirable. Where the crop is to be planted on a slope, a northern slope is recommended and the rows should cross the slope. Summer-fallowing, and plowing-in a moderate application of well rotted manure when the land is being plowed for summer-fallowing, is desirable preparation.

Planting.—Planting for the main crop should not be delayed too long, as earlier plantings usually give better yields than later plantings. Suitable dates are usually from May 10th to May 20th depending upon the district and the season. Under average conditions the depth of planting should be about four inches. In heavy soils the planting might be a little shallower and in light soils it might be deeper. The sets may be spaced twelve inches apart in the row where irrigation is to be practised or where moisture conditions are very favorable, but up to twenty-four inch spacings may be used to advantage, where moisture will be less abundant. Rows in the farm garden should be at least three feet apart to allow room for cultivation and to avoid undue crowding.

Culture.—Cultivation should be shallow and should be completed by the time the plants have reached full bloom. Mulching may be helpful under dry conditions. Hilling has virtue in protecting the tubers near the surface against greening and against injury from heavy frosts.

Harvesting and Storage.—Potatoes for storage should be harvested soon after the tubers reach a reasonable degree of maturity—when the skin is well set and is not injured seriously with ordinary handling. Harvesting should not be delayed beyond the end of September. Freshly dug tubers may be spread out on the ground and allowed to dry for a short time before transfer to storage. Undue mechanical injury to the tubers should be avoided through the exercise of care in digging and handling. The storage should be well ventilated during the fall months. Winter storage temperatures should be between 36 and 40°F.

Diseases.—Bacterial Ring Rot (Corynebacterium sepedonicum). Diseased plants show wilting which may be confined to one or more branches of the vine. Some of the tubers from diseased plants rot in the field. In the earlier stages of disease, tubers show a light brown, cheesy rot which is more or less confined to a ring a short distance below the skin. Many of the tubers which are apparently sound when dug will develop the characteristic rot during storage. Bacterial Ring Rot overwinters chiefly in diseased tubers and not in soil in the field. Control measures involve obtaining disease-free seed and not allowing it to come in contact with diseased seed, or sacks or bins which have held diseased seed. The latter should be disinfected thoroughly before seed is placed in them. Tools and implements should be disinfected if there is reason to think that they might have been used in planting or digging diseased potatoes. Growers should be on the look-out for the disease. Specimens of vines and tubers under suspicion should be sent to the Dominion Laboratory of Plant Pathology, Saskatoon, Sask. Only tubers that are slightly affected should be sent, as badly decayed tubers are useless for microscopic examination. Literature will be supplied on this disease by writing to the above address.

Storage bins may be disinfected by spraying with whitewash to which has been added one pound of bluestone in ten gallons of water, or formalin may be used at the strength of one pint to twenty-five gallons of water. The latter is satisfactory for spraying or washing contaminated machinery and for disinfecting sacks. Sacks should be soaked for two hours and then hung up to dry. It is a desirable practice to disinfect the knife frequently when cutting sets. For this purpose a five percent lysol solution (three teaspoonfuls in one cup of water) is recommended.

Other diseases attacking the potato are: Blackleg, Wilts, Rhizoctonia, Scab and several caused by viruses. Information regarding these may be found on pages 89 and 90.

Insect Pests.—Common pests attacking the potato are: Colorado Potato Beetle, Wireworms, Flea-beetles, Leafhoppers, Blister Beetles and Grasshoppers. Information regarding these may be found on pages 89 and 90.

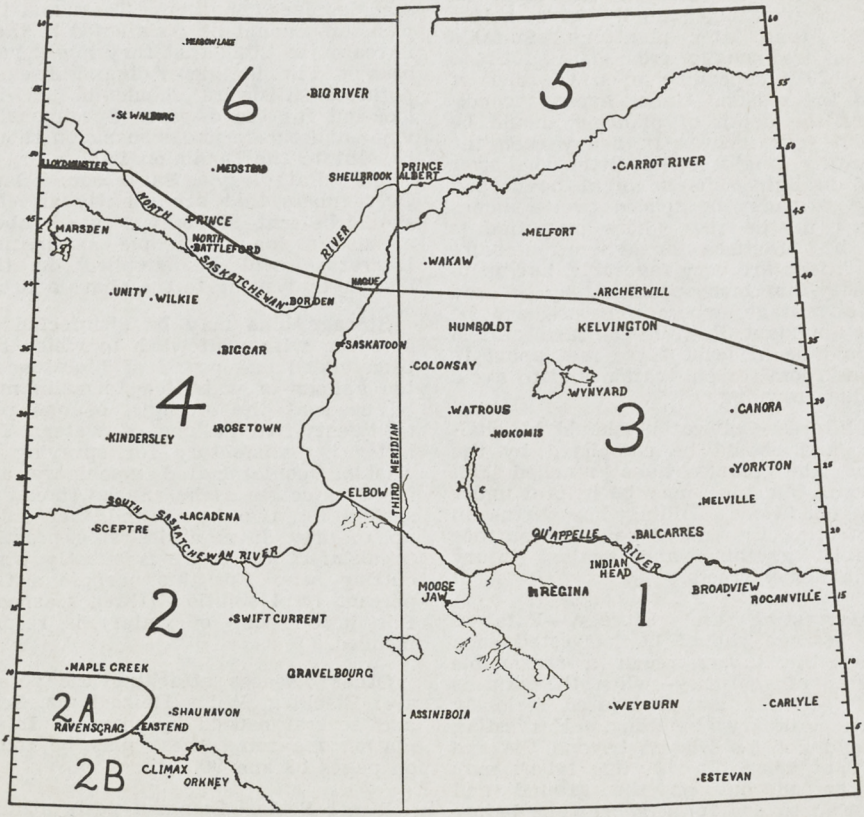
Seed Potato Certification.—Information on the production of certified seed potatoes and lists of growers in Saskatchewan having seed potatoes for sale may be obtained from the District Inspector, Seed Potato Certification Office, Post Office Building, Estevan, Saskatchewan.

FRUIT GROWING

Varieties.—Variety in fruits is even more important than is variety in vegetables. The need for extreme hardiness, for marked tolerance to a limited supply of moisture and for early maturity in fruits, places the matter of variety next to shelter in importance. Without proper guidance in the matter of selection of varieties, growers have, in many cases, made the mistake of choosing varieties unsuited to their conditions. Information on varieties in fruits is contained in the sub-section below.

ZONING FRUITS

Varieties of fruits differ greatly in their regional adaptation. Certain varieties that do well in one section of the Province may not do well in another section. A map dividing the Province into convenient zones appears below and a table indicating the suitability to each zone of a selected list of fruits may be found on page 65.



S = Satisfactory T = For Trial only
F = Fair U = Unsatisfactory
– = Information lacking

Kind	Variety	Zones							
		1	2	2A	2B	3	4	5	6
Apples	Blushed Calville	T	F	–	–	T	T	–	T
	Heyer No. 12	F	S	T	T	T	F	F	T
Crab-apples	Adam	S	S	–	–	S	S	S	S
	Amur	S	S	S	–	S	S	S	T
	Bedford	S	S	–	–	S	S	S	–
	Calros	S	S	–	–	F	S	S	T
	Columbia	S	S	S	–	S	S	T	T
	Dolgo	S	S	–	S	S	S	S	S
	Florence	F	F	–	S	F	F	F	F
	Mecca (Anaros)	S	S	–	–	S	S	S	T
	Osman	S	S	S	S	S	S	F	S
	Renown	S	T	–	–	T	T	–	–
	Robin	S	S	–	–	S	S	S	S
	Saska	S	T	–	–	S	T	–	–
	Silvia	S	S	–	–	S	S	F	S
Crab-apple x Apple Hybrids	Jewel x Rideau	S	T	–	–	F	F	–	T
	Piotosh	F	F	–	–	T	F	U	–
	Rescue	S	T	–	–	T	S	F	F
	Rosilda	F	F	–	–	T	U	U	–
	Trail	F	S	T	T	T	F	S	–
Plums **Native**	Assiniboine	S	S	S	S	S	S	S	F
	Bounty	S	T	–	–	S	S	T	F
	Dandy	S	T	S	S	S	S	S	F
	Grenville	T	T	–	–	T	U	T	–
	Mammoth	S	F	–	–	S	S	F	–
	McRobert	S	T	–	–	S	F	F	T
	Norther	S	T	–	–	T	T	–	–
Hybrid	Cree	S	S	–	–	S	S	T	T
	Objibwa	F	F	–	–	F	F	F	–
	Pembina	S	F	–	T	F	F	F	T
	Tecumseh	S	S	–	–	T	T	T	–
Sandcherry x Plum Hybrids	Compass	F	F	–	–	T	F	T	U
	Dura	T	T	–	–	T	U	F	–
	Ezaptan	F	F	–	–	F	F	S	–
	Heaver	T	T	–	–	T	T	T	–
	Opata	S	S	T	T	S	S	S	S
	Sapa	F	F	–	–	F	F	S	T
	Tom Thumb	S	S	T	T	S	F	S	S
	Manor	T	T	–	T	T	T	F	–
Sandcherry	Brooks	S	S	S	S	S	S	S	S
	Champa	S	S	–	–	S	S	S	F
	Manmoor	S	S	–	–	S	S	F	T
	Ruby	S	S	–	–	S	S	S	S
	Sioux	S	S	–	–	S	S	S	S
Cherry Nanking	Nanking (P. tomentosa)	F	T	–	–	F	T	–	T
Sour	(P. cerasus *and* P. fruticosa)	T	T	–	–	T	T	T	T
Grapes	*Beta	S	T	–	–	F	U	–	T
	*Hungarian	S	T	–	–	F	U	–	–
	Manitoba Native	S	T	–	–	S	F	–	T
Raspberry	Chief	S	F	T	T	S	S	S	S
	*Herbert	S	F	–	–	S	F	F	F
	*Latham	S	F	–	–	S	F	S	F
	Starlight	S	F	–	–	S	F	T	S
	Sunbeam	S	F	T	T	S	F	F	F
	*Viking	S	F	–	–	S	F	F	F
Strawberry June-bearing	Dunlap	S	S	S	T	S	S	S	S
Ever-bearing	Gem	S	T	S	T	S	S	S	S
	Pixie	T	T	–	–	T	T	T	T
Currants, Red	Cascade	T	T	–	–	T	T	T	T
	Fay's Prolific	S	S	–	–	S	S	S	S
	Perfection	S	S	S	S	S	S	F	S
	Red Lake	S	T	–	–	F	S	T	S
	Stephens No. 9	S	T	–	–	S	S	S	S
White	White Grape	S	S	–	–	S	S	S	S
Black	Boskoop Giant	F	F	–	–	S	S	F	S
	Climax	S	S	–	–	S	S	S	S
	Kerry	S	S	S	S	S	S	S	S
	Magnus	S	S	S	S	S	S	S	S
	Missouri	S	S	–	–	S	S	–	S

*Requires winter covering.

Kind	Variety	Zones							
		1	2	2A	2B	3	4	5	6
Gooseberry	Abundance	S	S	S	S	S	S	S	S
	Oregon Champion	S	T	–	–	S	S	S	T
	Pembina Pride (Thoreson)	S	T	–	–	F	T	–	T
	Pixwell	S	S	S	S	S	S	F	S

Site for Fruits.—A site similar to that outlined in the section on vegetables is desirable for fruits. A very gentle slope toward the east or north is considered the best for fruits. A southern slope is not objectionable provided the grade is very easy. Shelter is of prime importance and this should be provided on the north, west and south sides.

Important.—All named varieties of apples, crab-apples, plums and cherries are, for all practical purposes, self-unfruitful and plants of any one variety planted alone will be unfruitful. Plants of two varieties at least of the same kind of fruit are necessary for fruitfulness and three or four varieties are preferable. The use of several plants of one variety will not result in fruitfulness any more than will the use of one plant of that variety because all plants of a given variety, where increase is made by vegetative methods, are identical. One kind of fruit is not interfertile with another kind, as the apple with the plum, but crab-apples and apples are interfertile, as are also the sand cherries mentioned and the plum x sand-cherry hybrids as Opata and Sapa, Tom Thumb and Oka. The hybrid plums listed above are not sufficiently interfertile among themselves to be grown successfully alone but are interfertile with the other plums listed.

Propagation of Fruits.—The beginner is cautioned against starting with anything other than named varieties and these are not to be confused with seedlings of named varieties. Named varieties of fruits do not come true to variety from seed. When sown, seeds of Osman crab-apple will result in plants of crab-apple but not in plants of the Osman variety. No two of thousands of seedlings grown are likely to be found identical and not one will be identical with either parent. Increase in named varieties of fruits must be made through the use of vegetative parts of the plant, such as buds, branches and roots, and is usually effected by budding, grafting, and layering, and the use of cuttings, runners, and suckers.

Number of Plants Required.—To supply a family of average size with abundance of fruit, plants would be required as follows: crab-apples, plums and plum x sand-cherry hybrids, eight to ten of each; red raspberries, one hundred to two hundred plants; strawberries, one hundred to two hundred plants; black currants, red currants and gooseberries, six to twelve plants of each. Varieties of the same kinds of fruits should be planted close together to insure favorable conditions for proper pollination.

Spacings.—Generous spacings are recommended for fruit plants. Where the moisture supply is likely to be low, wide spacings are desirable. The spacings recommended for average conditions are as follows; crab-apples and plums sixteen to twenty feet; plum x sand-cherry hybrids, eight to twelve feet; red raspberry, rows eight feet apart; currants and gooseberries, rows six feet apart; strawberry, rows four to five feet apart.

Planting.—In all fruits the planting should be done early in the spring. For all excepting the strawberry planting in April is desirable. The setting of strawberry plants can frequently be delayed to advantage until early in May, or until some growth has been made. The precautions to be taken in the planting of trees for shelter should be taken in the planting of fruits also.

Pruning.—Plants of crab-apple, plums and cherries should be cut back to within twelve to fifteen inches of the ground level immediately after being planted. One year later, branches produced from the stub should be thinned to five. These should be uniformly distributed over this stub and should be cut back to one third their length.

Plants of currants and gooseberries should be cut back to within three or four inches of their bases at planting time and those of the red raspberry back to within eight to twelve inches of the ground level. Raspberry, currant and gooseberry plants must be pruned correctly, annually, if good crops of fruit are to be obtained.

Winter Protection.—Canes of the less hardy varieties of the red raspberry should be bent over and covered with soil just before winter sets in. Plants

The crab-apple is a dependable fruit for Saskatchewan gardens.

of the strawberry should be mulched with hay or clean coarse straw soon after the ground becomes frozen. Vines of named varieties of the grape should be covered with soil late in the autumn.

The soil covering raspberry canes and grape vines and the mulch covering strawberries should be removed in the spring before appreciable growth takes place.

Fireblight in Apples.—This is a serious disease in certain varieties of apples and crab-apples in Saskatchewan. It is a bacterial disease and it usually spreads rapidly. Branches of trees attacked by the disease may be killed back several feet in one season. Some varieties are susceptible to the disease but many are not. The best control measure is that of the use of resistant varieties. All of the varieties of crab-apples recommended in the list appear to have considerable resistance to the disease. However, some of them may become attacked if they come in contact with the disease. Much can be done to keep the orchard productive under such conditions by thorough pruning out of all diseased branches. The best time to prune is during the dormant season, when it is not necessary to disinfect the tools. Removal of infected twigs as they appear during the summer is desirable. In this case, the pruning tools should be kept moist with a disinfectant, mercuric chloride (1-1,000) or formalin (1-300), and the diseased material should be destroyed.

Protection of Fruit Plants against Rabbits and Mice.—Fencing the plantation with a rabbit proof fence offers an effective protection against rabbits provided (a) the fence is kept in good repair, (b) snow-drifts are not allowed to cover the fence and (c) rabbits on the inside are destroyed. Trapping, snaring, poisoning and shooting assists greatly in reducing the numbers of rabbits.

The short tailed field mouse frequently becomes one of the most serious pests around gardens and orchards. They may work under cover of snow or during the growing season. Cleaning up grassy or weedy headlands and poisoning offer the best general control for these pests. Gopher poison mixed according to directions and placed in tin cans under a forkful of straw or a sheaf of oats has given good results. These poison bait stations should be placed 25 to 50 feet apart around the outside of the plantation. It is also important that the poison be replenished before freezeup and heavy falls of snow occur. All rodents tend to migrate and one should be on guard against them appearing suddenly in serious numbers. Repellents have not been widely tested. Two or three pounds of resin dissolved

in a gallon of grain alcohol and painted, sprayed or brushed on twigs and bark has given satisfactory protection in certain cases.

Honeybees and Fruit Growing.—Honeybees are often an asset in fruit growing. Cross-pollination is necessary if the plants of certain fruits are to be fruitful. While other insects are instrumental in making the necessary transfer of pollen, the honeybee is one of the best carriers of pollen and its presence insures that proper pollination will take place. One good colony of bees is ample for a fruit plantation, one or two acres in extent. It is suggested that farmers growing fruit give serious consideration to the keeping of bees.

ORNAMENTAL GARDENING

Some attention should be given to the beautification of the home grounds beyond that of planting trees primarily for shelter. Beautiful grounds are uplifting to the community and are a joy to possess, and these should be regarded as an essential part of the home of a progressive farmer. The home grounds should be laid out according to a definite plan that embodies both utility and beauty. Provision should be made in the plan for a lawn area and for the use of ornamental shrubs, flowers and specimen trees. A plan that is too ambitious should be avoided and one that fits into the natural landscape, that is practicable under the existing circumstances and that can be executed properly, even though it may be simple, is recommended. It is essential that the grounds be maintained in good condition and a small area well kept is preferable to a larger area partially neglected. Only hardy, drought-resistant, and tried planting materials should be employed. Certain native shrubs can often be used to advantage. Both annual flowers and perennial flowers are recommended. In annuals, those that can be started outdoors are more desirable for use on the farm in most cases than those that require starting indoors. Perennials that require little care after planting are preferable to those demanding attention at frequent intervals.

Annuals.—A short list of dependable annual flowers that can be grown successfully from seed sown out of doors is as follows: **Lower-growing**—Bartonia, California Poppy, Candytuft, Dwarf Nasturtium, French Marigold, Godetia, Love-in-a-Mist, Mignonette, Phacelia, Portulaca, Scarlet Flax, Sweet Alyssum, Virginia Stocks; **Taller-growing**—Balsam, Calendula, Corn Flower, Cosmos, Larkspur, Lavatera, Lupine (annual), Pin-Cushion Flower (Scabiosa), Prince's Feather (Amaranthus), Shirley Poppy, Sweet Sultan, Zinnia. **Climbers**—Wild Cucumber, Sweet Pea, Common Nasturtium and Canary Nasturtium. A few outstanding annuals grown from seed usually sown indoors late in March and which are obtainable in considerable variety are: Annual Phlox, Pansies, Petunias, Snapdragons, Stocks and Sweet Scented Tobacco. Tender perennials grown as annuals and that have outstanding merit are: the Gladiolus and Dwarf Early-Flowering Dahlias.

Perennials.—A short list of dependable herbaceous perennial flowers that can be grown successfully in Saskatchewan is as follows: **Lower-growing**—Basket of Gold (Alyssum saxatile), Carpathian Harebell, Coral Lily, Dwarf Iris, Grass Pink, Haage Campion (Lychnis haageana), Iceland Poppy, Maiden Pink, Moss Pink, Rock Cress, Thunberg's Lily, Tulips; **Taller-growing**—Baby's Breath, Chimney Bellflower, Columbine, Delphinium, Golden Glow, Golden Marguerite, Jacob's Ladder, Peonies, Pyramidal White Phlox, Pyrethrum, Scarlet Lychnis, Siberian Lavatera, Spike Speedwell, Sweet Rocket, German Iris, Siberian Iris, Day Lilies; the Candlestick, Maxwill, Tiger, and Willmott's Lilies. All can be propagated readily by seed excepting named Irises, named Peonies, the Day Lilies, most of the Lilies, Tulips, Golden Glow and Moss Pink, which are usually propagated by division.

Shrubs.—A short list of hardy dependable ornamental flowering shrubs suitable for use in Saskatchewan is as follows: **Low-growing to medium height** (up to four feet in height)—Russian Almond, Stanwell's Perpetual and Dr. Merkeley Roses, Dwarf Pea-Tree, Oriental Spirea, Pikow Spirea, Peking Cotoneaster, European Cotoneaster, Red Osier Dogwood, Sweetberry, Honeysuckle and Shrubby Cinquefoil; **Taller-growing**—Tartarian Honeysuckle, Manchurian Honeysuckle, Salt Tree, French Lilacs, Korean Lilac (S. dilatata), Late Lilac (S. villosa), Hungarian Lilac (S. josikaea), Hybrid Lilacs; Harison's Yellow, Hansa, Tetonkaha, Betty Bland, John McNab, Scotch and Kamschatka Roses; Missouri Currant, Tartarian Maple, Amur Maple, American Mountain-Ash, American Cranberry Bush,

Siberian Crabapple, Common Caragana (Siberian Pea-Tree), Lorberg's Caragana, and Russian Pea-Tree; **Native Shrubs**—Pincherry, Chokecherry, Buffaloberry, Saskatoon and Wild plums; **Woody Climbers** — Virginia Creeper, Western Virgin's Bower (Native Clematis), Chinese Clematis and Manitoba Wildgrape.

LAWN MAKING

Important grasses for use in making lawns in this Province are Kentucky Blue, Chewing's Fescue, Creeping Red Fescue and the Fairway strain of Crested Wheat. Kentucky Blue and Chewing's Fescue are capable of making excellent turfs but they have very limited drouth-resistance and are recommended for use only where artificial waterings can be given or where nature's supply of moisture is reasonably abundant. If desired, white Dutch Clover to the extent of five to ten percent might be used with Kentucky Blue grass. Crested Wheat grass does not make a closely knitted turf but has great drought-resistance and is recommended for use where the giving of artificial waterings is not practicable and where the natural moisture supply is too low to permit the growing of superior turf grasses. On small areas Kentucky Blue grass should be seeded at the rate of one pound of seed to one hundred and fifty or two hundred square feet and Chewing's Fescue, Creeping Red Fescue and the Fairway strain of Crested Wheat at the rate of one pound to one hundred square feet of lawn surface area. Where the areas are large and where economies must be effected, thinner seedings may be made but reductions in the amount of seed used usually involve some sacrifice in the quality of the lawn resulting, during the earlier years at least. The rates of seeding recommended are based on the use of seed of good quality. New-crop seed should be insisted upon in the Fescues as this seed frequently deteriorates rapidly. While a successful lawn may be obtained from seeding at different times, probably the best time for this operation, in most sections of the Province, all things considered, is about the end of May or the first week in June. Crested Wheat grass may often be seeded successfully early in September, just before winter sets in or early in the spring. Seeding during the hot dry months should be avoided where artificial watering cannot be practised. The area to be grassed should be graded and summerfallowed during the year previous to that of seeding. On small areas the seed can be raked in with a garden rake. On large areas, the seed can be drilled in shallowly, using a seed-drill.

Dandelion Control in Lawns.—Dandelions can be controlled in most lawns through the use of 2,4-D. The blue grasses, fescues and Crested Wheat grass are resistant to the chemical used at ordinary rates of application, but the Bent grasses show some sensitivity. The safest form for use on lawns and near flowers, shrubs and trees is the sodium salt. This should be used according to directions on the container and great care should be exercised to confine the spray to the area being treated. As far as is known, most flowers, vegetables, shrubs and trees are sensitive to the chemical and drifting spray reaching them may do serious damage. Application should be made on a calm day and the material being applied should be under full control. The solution may be applied as a spray or it may be applied from a watering can provided with a fine rosette. Dandelions should be treated when actively growing and when the leaf surface is in a dry condition. At least a few hours should elapse between treatment and the occurrence of rain or the use of a sprinkler on the area. Atmospheric temperatures between 60° and 80°F. at the time of application are desirable. Treated dandelion plants may be cut even with the ground surface four days after the treatment is given, without decreasing the kill. Spruce trees are moderately tolerant to 2,4-D and the spray can be used safely near the branches. Equipment used in applying this chemical should not be used either in watering or in spraying cultivated plants.

IRRIGATING THE FARM GARDEN

Conservation Methods.—In certain sections of the Province, a successful farm garden can be insured only by the conservation of water from melting snows and by irrigation. This water is necessary to provide the moisture required not only by the garden crops, but also by the trees supplying the shelter for the garden area. Conservation involves the building of dams and

dugouts for the storage of the water that is to be released for irrigation purposes later. Sufficient of the water thus conserved should be used to insure normal tree growth and the production of garden crops, and any surplus that remains may be used for other crops.

Assistance in the building of dams and dugouts for purposes of irrigation is given, under the Dominion Prairie Farm Rehabilitation Act, to farmers in the areas of the Province of Saskatchewan wherein this Act is operative.

Under this Act, farmers may receive (1) a grant in cash for the labor involved, (2) the services of an engineer to take levels in the area or areas concerned, and (3) advice on the details of procedure in the construction of the dam and dugout and on the use of the water thus conserved.

The project of conserving water from melting snow, and utilizing this water in the irrigation of garden crops is practicable on many farms in the dry areas. Already the utilization of such water for such purposes has resulted in many cases in a good return from the garden, where almost total failure would have resulted otherwise.

Various methods of conserving and storing water have been employed and are recommended. These are:

(a) Building a dam across a watercourse and applying the stored water by gravity to the garden area at a lower level. The water may be taken from the storage through a pipe in the lower part of the dam, or through an open sluiceway in the dam and led to the garden through small open ditches. Water stored in this way may be used to soak the garden area soon after the frost has escaped from the upper layers of soil, and before seeding and planting. Where the subsoil will not permit the rapid escape of the water in the storage to the layers of soil below, an irrigation may be given the area before seeding and planting as suggested above, and later in the season, irrigations may be given the growing crops as conditions permit. Spring irrigation may be given through the use of a dyke around the garden, and by flooding the area, but water used after the crop is in should be run down between the rows. Where the area is not sufficiently level to permit flooding the entire area at one time, contour-dykes should be constructed. These may be provided merely by plowing contour-furrows in the fall to hold the water at different levels.

(b) Impounding the water from the melting snows by building a dyke around the garden area, and either around or through the tree belt, and building temporary dykes at intervals through the garden area when necessary. This is practicable only where the land is reasonably level. While only a spring irrigation could be given with this treatment, such an irrigation might easily result in a successful garden where failure would be experienced without this additional moisture.

(c) The use of a dugout near the garden with a pump to elevate the water to the required level. Facilities for catching snow to supply the water, such as trees and snow-fences, must be provided along the runways, and the dugout must be so placed that the movement of water from the nearby areas will be in its direction. A retentive subsoil is essential to prevent undue losses of water to the soil below.

(d) A combination dugout and dyked garden area adjacent to the dugout. In some areas it may be possible to locate the garden so that it could be flooded by the overflow from the dugout. This might necessitate the building of a dyke around the garden area. This dyke could be constructed of the material excavated from the dugout. Such a dyke should be about two feet in height and should have a gate to control any surplus water. Water pumped from the dugout could be used to give irrigations during the growing season, provided the dugout contains a surplus over and above the amount required for household use and for livestock. Trees or snow-fences should be provided when necessary to trap the snow required to supply the water that this combination demands.

Other Methods.—Water pumped from streams and wells can frequently be used to advantage in irrigating the garden. To be safe for such use, well-water must be low in salt content.

Suggestions for irrigating the vegetable garden.—Water applied in the form of irrigation is done in furrows between the rows and the first requirement is level land. Unless drought occurs in early summer, the sheltered garden does not require irrigation until the vegetables are in flower or have an adequately developed root system. Water is applied when the flowers appear in the case of peas, beans, potatoes and cucumbers and as soon as the tassels appear in the case of corn. For root vegetables including carrots, beets and parsnips water is applied

about three weeks after thinning. One application is usually sufficient for peas and beans; two or three for potatoes, corn, root crops, cabbage and celery. Where a second irrigation is required, this is given when the soil is becoming dry at a depth of six inches. At least three inches of water is given with each application. Cultivation following irrigation, as soon as the soil surface dries, is necessary.

Water Analyses Made by University.—Analyses of water samples are made free of charge by the Department of Chemistry, University of Saskatchewan, Saskatoon, Sask. A suitable bottle and complete directions for taking the sample are supplied by this Department. A deposit of one dollar is required when the request for an analysis is made. This deposit is returned when the sample of water for analysis has been received.

SOIL TESTS

In many cases the failure of garden plants and trees to thrive in a given area is traceable to some undesirable condition in the soil. This condition may be physical or it may be chemical. Samples of such soil may be submitted to the Department of Soils, University of Saskatchewan, Saskatoon, Sask., for examination and for a soluble salts test. This service is given free. Directions for taking samples of soil to be submitted will be found on page 20 of this publication.

PESTS AND DISEASES

These frequently do considerable damage to horticultural plants that are neglected. Fortunately, most of those attacking such plants in Saskatchewan respond well to treatment, and the application of standard measures of control at the proper times will either prevent injury or will reduce it greatly. Information regarding a number of the pests, with control measures, may be found on pages 103 to 105. Information regarding certain diseases may be found on pages 89 and 90. Special mention of Bacterial Ring Rot in the potato is made on pages 63 and 89. Special mention of Fire-Blight on the apple is made on pages 67 and 90. Further information regarding pests and diseases may be obtained from your Agricultural Representative, your nearest Dominion Experimental Station and from the University of Saskatchewan, Saskatoon, Sask. Where either the pest or the disease is not known, material for identification should be sent to one of the addresses mentioned above.

BULLETINS

Bulletins may be secured from the following sources:

On **Tree Planting** from the Forest Nursery Station, Indian Head, Sask.;

On **Vegetable Gardening** and on **Fruit Growing** from the Extension Department, University of Saskatchewan and the nearest Dominion Experimental Station;

On **Irrigation** from the Saskatchewan Department of Agriculture, Legislative Building, Regina, and the Dominion Department of Agriculture, Ottawa.

WEED CONTROL

With the exception of drouth, weeds probably cost the Saskatchewan farmer more in dollars and cents than any other of the many problems and hazards with which he is plagued. Weeds not only reduce the yield of grain, they also cost money in terms of extra cultivation, and extra expense in harvesting, threshing and marketing.

Everyone knows that weeds rob crops of moisture. Weeds also compete with crops for plant food and light. A plant of Wild Mustard in the bloom stage has twice as big a root system and about 52 times as great a leaf surface as a wheat plant of about the same age. In the seedling stage, however, weeds are not as strong as cereals. They are usually produced from tiny seeds and suffer severely from competition with the large seeded cereal crops if the crop has an earlier start. If weeds pass the seedling stage without much competition they develop rapidly and soon produce root systems and leaf surfaces that put them in a favoured position in competing with grain crops.

HOW WEEDS ARE GROUPED FOR CONTROL PURPOSES

Weeds in Saskatchewan can be divided into four groups according to their habits of growth. Methods of control must be based on how the weed grows. General principles of control can be set out for each of the following groups:

Annual Weeds—Weeds of this group grow from seed, produce new seed and die in the same summer. The most important annual weeds are: Wild Mustard, Wild Oats, Russian Thistle, Lamb's Quarters, Cow Cockle, Flixweed, Russian Pigweed, Red Root Pigweed, Wild Buckwheat, Tumble Weed, False Ragweed, American Dragonhead, Prickly Lettuce, Purslane, Darnel, Green and Yellow Foxtail and Tartary Buckwheat.

Winter Annual Weeds—Weeds of this group are annuals that can live over winter in a green condition. When their seeds germinate in the fall, they produce a rosette, live over winter, then continue growth early in the spring and produce seed and die during the summer. When their seeds germinate in the spring, they behave as annuals. The most important winter annual weeds are: Stinkweed, Pepper Grass, Shepherd's Purse, Tumbling Mustard, Hare's Ear Mustard, Ball Mustard, Blue Burr and Wormseed Mustard.

Note—In making use of recommendations in this section consideration must be given to modifications necessary because of special problems such as Soil Drifting, Insects and Plant Diseases. See pages 11, 91 and 81 respectively.

Biennials—Weeds of this group grow from seed one season, live over winter and produce seed and die the following season. Important biennial weeds are: Goat's Beard, Grey Tansy Mustard, Gumweed, Biennial Wormwood and Evening Primrose. Volunteer Sweet Clover can also be troublesome as a biennial weed.

Perennials—Perennials are plants that live more than two years. Weeds of this group produce seeds each season. The tops die down in the fall, or are frozen, and grow up again the next spring. Perennials that are most difficult to control spread not only from seeds but also from creeping underground rootstocks. Some of the most troublesome of the common perennial weeds are: Canada Thistle, Perennial Sow Thistle, Couch or Quack Grass, Toad Flax, Poverty Weed, Blue Lettuce and Wild Rose. Leafy Spurge, Hoary Cress, Russian Knapweed and Field Bindweed are very persistent perennials that occur at widely separated points in Saskatchewan. These four weeds are much more difficult to control or eradicate than Canada Thistle, Couch Grass or Perennial Sow Thistle and deserve special attention wherever they are found. Perennials that are sometimes troublesome, but that have no creeping rootstocks, are Dandelion and Wild Barley.

Legal Classification of Weeds—Noxious weeds are weeds whose seeds are termed "Noxious" in the Dominion Seeds Act. This Act divides Noxious Weed Seeds into three classes. The first is **"Prohibited Noxious Weeds,"** and they are: Leafy Spurge, Hoary Cress, Russian Knapweed, Field Bindweed and Dodder. No seed containing any seeds of these weeds can be legally advertised for sale in Canada. The next group is **"Primary Noxious Weeds,"** examples of which are: Couch Grass, Perennial Sow Thistle, Wild Mustard, Darnel, Bladder Campion, White Cockle and Great Rag-

weed. Registered and certified seed is not permitted to contain any Primary Noxious Weed seeds. Examples of the third group, **"Secondary Noxious Weeds"** are: Canada Thistle, Toad Flax, Poverty Weed, Stinkweed, Wild Oats, Russian Thistle, Cow Cockle, Purple Cockle, Flixweed, Peppergrass, and Ball, Tumbling and Hare's Ear Mustard.

The Noxious Weeds Act of Saskatchewan also names a number of weeds as "Noxious." In this Act, weeds are described as "Noxious" so that Weed Inspectors and municipalities may have certain powers with respect to their control.

GENERAL RECOMMENDATIONS FOR WEED CONTROL

Conscientious application of the following eight practices will assist in keeping weeds under control.

1. Sow only clean seed.

2. Control weeds on uncultivated land.

Fence lines, stack bottoms, field margins, road allowances and the barnyard are often allowed to produce heavy crops of weed seeds. Weeds are an aggressive enemy. Their seeds move into fields with the help of wind, water, drifting soil and snow, livestock, machinery, birds, etc. Seed all uncultivated parts of the farm to strongly competing grasses, such as brome or crested wheat.

3. **Avoid spreading weed seeds** with farm machinery, such as combines, hay racks, threshing machines, seed cleaning plants, etc.

Feed grain containing weed seeds should be ground thoroughly.

Screenings and weed seeds at threshing machine sets or from combines should be burned or otherwise disposed of. When hauling screenings or dirty grain, cover the wagon or truck box.

4. Make cultivation for weed control effective.

All cultivation should be properly timed and tillage machines should be correctly adjusted so that all top growth of weeds is completely destroyed. This applies especially to spring tillage for the control of biennials and winter annuals. Generally, shallow cultivation is best for weed control. Read the section on "Farm Machinery and Power" for suggestions on the proper adjustment of machinery.

5. Seed very weedy fields to grass or grass-legume mixtures.

Forage crops will control annual weeds and stunt or smother most perennials. Rotations with grass or with alfalfa-grass mixtures are advantageous not only from the soil improvement viewpoint, but also for weed control.

6. Use vigorous crops on weedy land.

Barley and rye offer stronger competition to weeds than do wheat and oats. Flax offers very little competition to weeds.

7. Watch for new weeds.

Nearly all the weeds that cause so much trouble and expense in Saskatchewan have been introduced and have spread out from small infestations. Leafy Spurge, Hoary Cress, Russian Knapweed and Field Bindweed are present but not yet common in the Province. They are more difficult to control or eradicate than any of the common perennial weeds. Tartary Buckwheat, an annual whose seeds cannot be cleaned out of wheat, is a serious problem in Alberta and has been found in Saskatchewan. Watch for strange plants and send specimens for identification to the nearest Dominion Experimental Station, the University of Saskatchewan or your Agricultural Representative.

Be careful in purchasing seed collections such as "Wild Flower Garden" mixtures and secure them only from reliable firms. There is good evidence that Toad Flax, a serious perennial, was so introduced. Nursery stock and particularly the packing around roots of shrubs or trees, may also be a source of weed introduction.

8. Encourage community effort.

Weeds do not recognize farm boundaries. The individual can clean up his farm, but unless his neighbors do likewise, he is constantly faced with new infestations. Rural municipalities may appoint Weed Inspectors to assist in weed control in the municipality. Agricultural committees are planning weed control programs for municipalities and Local Improvement Districts. Encourage and support your Agricultural Committee and Weed Inspector in their weed control programs.

The seeding of grass on roadsides that have been properly graded and backsloped is strongly recommended.

THE CONTROL OF ANNUAL WEEDS

The control measures described in this section apply also to Winter Annuals, **when they are growing as Annuals.**

The following are some characteristics of annual weeds that have an important bearing on control measures;

1. Most of the troublesome annual weeds will die if they are cut off below the ground surface and their roots exposed to the air, or if their tops are killed by chemicals.

2. Annual weeds produce heavy crops of seed. A single plant of Wild Mustard may produce 21,000, Stinkweed 7,000 and Green Tansy Mustard as many as 55,000 seeds.

3. Weed seeds in the ground do not all germinate in the same season. Usually only a small proportion of the seeds produced in any year germinate in the same or in the next season. Others, particularly if buried more than two or three inches, may remain in the soil for years and then germinate when brought nearer the surface.

4. Most weed seedlings in the early stages of growth are weak, and are not able to compete with vigorously growing crops.

SEEDING RECOMMENDATIONS

Cereal seedlings have larger and stronger root systems than most weed seedlings. A vigorous, dense, uniform stand of a cereal crop smothers many annual weed seedlings. This is the cheapest way to kill weeds.

A number of simple practices that help to produce a vigorous uniform stand of crop, with at least an equal start with the weeds, are listed below:

1. Destroy weeds before seeding.

Pre-seeding cultivation should be shallow but should destroy all weed growth. If cultivation is too deep, more weed seeds may be brought to the surface. Seed immediately after cultivation or a crop of new weeds may germinate before the grain is in the ground.

2. Seed at the Proper Depth.

Seed must be placed in moist soil before it will germinate but should not be sown deeper than is necessary to place it in moist soil. If seed is sown too deeply, germination is delayed and, as the seedlings take a long time to reach the surface, they lack vigor. Pre-seeding cultivation should be as shallow as possible as the soil rapidly dries out to the depth to which it has been worked. This cultivation may, therefore, determine the depth at which it is necessary to seed.

3. Sow Sound Seed.

Frosted, sprouted. musty or badly shrunken seed has low vitality. It produces a thin, weak stand which under adverse conditions cannot compete with weeds. See Section on "Plant Diseases" for information on seed treatment.

If in doubt as to the germination of seed, a test may be made at home, a sample may be taken to the local elevator agent who can arrange for a germination test, or a sample may be sent to the Plant Products Division, 523 Federal Building, Saskatoon.

4. Sow Uniformly.

Skips and misses in seeding, whether the fault of the operator or of the seed drill, leave open spaces or thinly seeded rows where weeds will flourish. The spacing and operation of a seed drill should be checked and faults corrected.

5. Rate of Seeding.

In the moister areas of the province the usual rate of seeding can be increased by as much as 50 percent on very weedy land. An increased rate of seeding usually results in many weeds being crowded out and the remainder do not produce as much seed.

6. Use of Fertilizer.

Where phosphate fertilizer gives a response it can assist the crop materially in overcoming weeds. The "kick" of phosphate fertilizer is usually most noticeable in early spring. The extra growth and vigor it gives to the crop is often sufficient to turn the scales in favor of the crop at the critical stage during which the root systems of the weeds are developing to the point where they can offer serious competition. Phosphate fertilizer also assists in the control of browning root rot which, by retarding the root development of a crop, often places it under a serious handicap.

GREEN SUMMERFALLOWING FOR THE CONTROL OF ANNUAL WEEDS

Although annual weeds in the soil cannot be eradicated in one year by any known method, their numbers, particularly in the top two or three inches of soil, can be greatly reduced by "Green Summerfallow." The basis of

this method is to "grow out and destroy" as many crops of weeds during the season as possible. The only way to rid the land of weed seeds is to get them to germinate and then destroy the seedlings.

Variations in procedure for Green Summerfallow may have to be made depending upon special problems. The following steps are recommended as a basic procedure.

1. Light fall cultivation preceding the summerfallow year.

Do this as soon as possible after harvesting. A very shallow discing is sufficient. The object is to disturb the surface of the soil sufficiently to cover weed seeds very lightly but to leave the stubble for soil protection and to catch snow.

Any weed growth that is started in the fall can be left for frosts to kill over winter. Winter annuals will survive and should be killed by early cultivation the following spring. In areas where moisture conservation is the main purpose of the summerfallow, it may be advisable to destroy winter annuals in the fall.

2. Shallow cultivate to kill spring growth.

The field for summerfallowing may be left untouched until seeding is completed, provided the weeds do not grow too large. Undue delay of the first cultivation of summerfallow allows weeds to rob the soil of moisture that should be conserved for the next year's crop. On some of the heavy textured soils, shallow spring cultivation may be necessary to start weed growth.

3. Destroy weeds by shallow cultivation before they grow to a height of two inches.

The summerfallow should not be cultivated unless there is a growth of weeds on it. Cultivation should be shallow and done **thoroughly** so that all weeds are destroyed.

4. Leave annual weeds that germinate in late September for killing by frost.

This practice saves cultivation and also leaves some material as a protection for the soil surface during the fall and winter. Where moisture conservation is a major consideration, winter annuals particularly, should be destroyed in the fall.

SPECIAL CONTROL METHODS FOR SPECIFIC ANNUAL WEEDS

Wild Oats.—The practices outlined under seeding recommendations and Green Summerfallow are valuable in Wild Oat control, but seedlings should be allowed to reach a height of 3 to 4 inches before cultivation. In areas of the Province especially troubled by Wild Oats, shallow fall tillage of all stubble fields has been very helpful.

On badly infested fields early maturing barley may ripen before the Wild Oats have shattered. The seeding of oats or barley and harvesting them for hay before Wild Oat seeds have developed is recommended. Delaying seeding until a crop of Wild Oats has been destroyed has proven effective in reducing the number of Wild Oats in those parts of the Province having favorable moisture conditions.

Russian Thistle.—Two factors make Russian Thistle especially difficult to control. The most important is that this weed is generally troublesome in areas where soil drifting is also a serious problem. The other is that seeds of Russian Thistle germinate freely throughout the season. Recommendations outlined above for annual weed control are effective against Russian Thistle although they may have to be modified to guard against soil drifting.

CHEMICAL CONTROL OF ANNUAL WEEDS

The spectacular advance made in chemical weed control by the introduction of 2,4-D has lent a new enthusiasm to weed control efforts. However, too great dependence on chemicals should be avoided. There is not yet a single "cure-all" for the weed problem; there probably never will be. The new selective chemicals should be regarded as a valuable addition to other tried and proven measures for weed control.

CHEMICAL WEED CONTROL IN GROWING CROPS

Contact Weed Killers.—They kill by "burning" the leaves. Examples of this group are "Sinox" and "Dow's Selective Weed Killer." If properly applied, this type of chemical does no harm to the crop. Contact weed killers should be handled with caution since they have caused serious injury to humans when the chemical was allowed to contact the skin too freely.

Contact weed killers are most effective on Wild Mustard and Stinkweed. The greatest benefit from their use is secured in a good growing season, that is when moisture and warmth are present in such degree that the crop can take maximum advantage of the removal of weeds. Under adverse conditions for crop development, especially when the season is unusually hot or cold or dry, contact weed killers will not give satisfactory control.

Although contact weed killers are considerably more expensive and their application at the present time more troublesome because of a larger water requirement, they have an important advantage over 2,4-D in that weeds are killed quickly. Where only susceptible weeds are involved and growing conditions are right, the use of selective weed killers of this type has given greater yield increases than 2,4-D.

Growth Regulating Weed Killer, typified by 2,4-D.—It does not "burn" the leaves of the plant but enters its tissues and kills or damages it by disturbing its growth processes. This chemical offers much promise in weed control. It is relatively inexpensive, is easily applied and may be applied at any time of the day or night. It is not corrosive, nor inflammable, nor poisonous to humans and warm blooded animals.

For detailed information on the use of 2,4-D, write for the pamphlet "2,4-D Agricultural Uses in Saskatchewan," published by the Saskatchewan Advisory Weed Council and available from any Dominion Experimental Station, the University of Saskatchewan or your Agricultural Representative. The following is a brief summary of recommendations and findings based on experiments conducted with 2,4-D from 1945 to 1947.

1. 2,4-D may damage crops. Do not apply before grain crops are five inches high, flax four inches high, nor for at least three weeks after emergence, nor after the late shot blade stage, or the late bud stage in flax.

2. Many valuable crops and plants are very susceptible to 2,4-D. It should not be used on such crops as alfalfa, sweet clover, peas and other legumes nor on rape. Many trees and almost all garden crops are very susceptible to 2,4-D. When using it in the vicinity of trees and gardens or susceptible crops, it should be applied only when the wind direction will carry the drift away from the susceptible plants.

3. Common weeds may be grouped as follows for susceptibility to 2,4-D:

(a) Very susceptible—Wild Mustard, Stinkweed and Tumbling, Ball and Indian Mustard.

(b) Intermediate in susceptibility — Russian Thistle, Lamb's Quarters, Russian Pigweed, Blue Burr, Tumbleweed, Flixweed, Red Root Pigweed, Hare's Ear Mustard and Goosefoot.

(c) Resistant — Cow Cockle, Purple cockle, Peppergrass, Wild Buckwheat and weeds of the grass family, such as Wild Oats, the Foxtails, etc.

4. Weeds are most susceptible when very young. Stinkweed for example is very susceptible until it starts flowering, when its resistance increases until it is very difficult to kill in the pod or seed stage. Similarly Russian Thistle is susceptible in the seedling stage but soon after the side branches develop, it rapidly becomes quite resistant.

5. In the amount of 2,4-D required to produce effective kills the common formulations rank as follows: **Ester** formulations act most quickly and require the least amounts, **amines** are intermediate and the **sodium** types require the largest quantities and take the longest time to kill weeds.

6. The three formulations rank as follows in their tendency to damage cereals and flax: Esters are most likely to cause damage, followed by amines and the sodium salts.

7. Recommended rates of application of 2,4-D Acid Equivalent for the three formulations in cereal crops are from six to 12 ounces per acre for the sodium preparations, four to eight for amines and three to six for the esters, depending upon the stage of growth and the degree of resistance of the weeds being treated.

8. When applications are made uniformly at the proper rate, and adequate precautions are taken against drift, there appears to be little difference whether 2,4-D is applied as dust or liquid.

THE CONTROL OF WINTER ANNUAL AND BIENNIAL WEEDS

Ability to survive the winter and continue growth in the spring from a tough, well developed root system is the characteristic that enables winter annual and biennial weeds to survive. Methods for the control of annual weeds,

if carefully followed, will also control these two groups.

The importance of effective pre-seeding cultivation should be emphasized. Unless this cultivation is done with the proper machinery, well adjusted, winter annuals and biennials may escape. Where this occurs, the young crop seedlings cannot compete successfully with these weeds which already have well developed root systems.

THE CONTROL OF PERENNIAL WEEDS

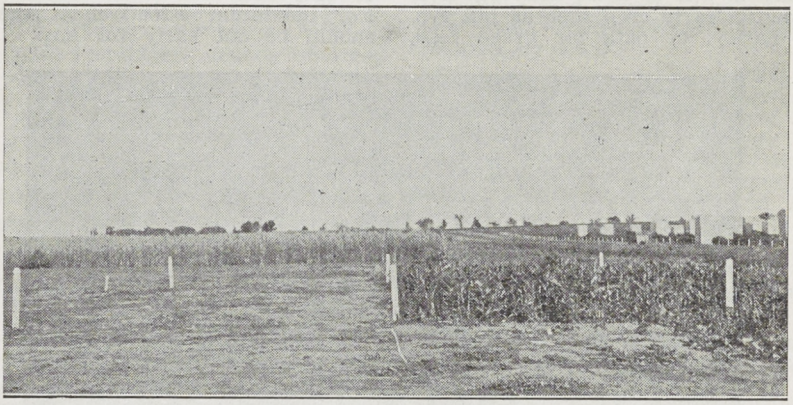
Creeping underground rootstocks make common perennial weeds formidable pests. These rootstocks serve the plant in two ways:

1. As a means of propagation. A single plant without competition can cover an area up to 15 feet in diameter, or almost 200 square feet, in a single season by means of these rootstocks. If it contains a bud, a piece of one of these rootstocks only half an inch long can start a new plant which can cover a similar area in a season.

2. For the storage of food. In the normal growth cycle, a perennial plant starts in the spring with a heavy reserve of food stored in its root system. As the season progresses, the stored food is gradually used and reaches a low point at the time of flowering and seed setting. After that, the food reserves are rapidly replenished until by fall they are fully restored and ready for the next season.

The root system is the major consideration in the eradication or control of perennial weeds. Unless a practice seriously weakens or kills the root system, it is of little value as a control measure.

Most perennials also spread by seeds. It is, therefore, important to prevent their seeding to avoid new infestations.



The left half of the photograph shows the area from which perennial sow thistle was eradicated by the black summerfallow method (shallow cultivation) extending over a period of 12 weeks; the other half shows the original infestation. The picture was taken one year after the field received the treatment.—Laboratory of Plant Ecology, University of Saskatchewan, and the National Research Council of Canada.

BLACK SUMMERFALLOWING FOR PERENNIAL WEED CONTROL

This is the most important cultural method for the eradication of perennial weeds. The purpose of the black summerfallow is to starve the root systems. The perennial produces new shoots by using the food reserves in the roots. If new shoots are allowed to grow, they will begin to rebuild the food reserves in the rootstocks. For this reason it is necessary to cultivate often enough to prevent the appearance of new shoots.

Important principles of the black summerfallow method are as follows:

1. Start Black Fallow Operations When the Roots are Weakest.

Because food reserves are at their lowest about flowering time, this is the time to start the black fallow. This time will vary with different plants and in different seasons. It is about June 15 for Couch Grass, July 1 for Sow Thistle and July 15 for Canada Thistle.

2. Keep the Fallow Black.

The summerfallow should be cultivated often enough to prevent any green shoots from making an appear-

ance. The number of cultivations required will vary. Once a week may be necessary at the beginning, if growing conditions are favourable. Less frequent cultivations will be required as the season progresses. It usually takes about 10 to 12 weeks to eradicate Sow Thistle, 14 weeks to eradicate Couch Grass, and until freeze-up to eradicate Canada Thistle.

3. Do Not Attempt to "Drag Out" the Root Systems.

Most of the root systems are out of reach of common tillage machinery. Avoid the use of machines that will drag the roots. If pieces of root are dragged to clean parts of a field new infestations will be started.

4. Guard Against Soil Drifting.

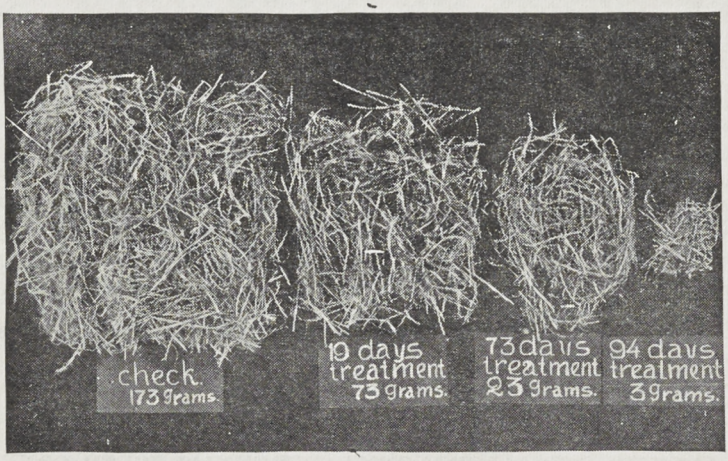
The number of tillage operations required for black summerfallowing will reduce the soil to a fine state of pulverization. In areas or on soils subject to soil drifting, the black fallow method must be modified to minimize the drifting hazard. One of these adaptations is to grow an early crop such as fall rye, early barley, or oats for green feed, then work the land immediately behind the harvesting machinery, keeping it black till fall.

5. Insect Control.

In areas where the annual forecast indicates that a severe outbreak of pale western cutworms may be expected, it is necessary to leave fields undisturbed between August 1 and September 15. In such cases eradication of perennial weeds cannot be expected.

6. Mixtures of Annual and Perennial Weeds.

In fields infested exclusively with annual or perennial weeds, control is relatively simple. In many fields some modification of the black summerfallow method is necessary to provide a measure of control of annuals. This is usually best done by one or two shallow cultivations in the spring and early summer, following which perennials are allowed to grow before commencing the black summerfallow. Another modification is to grow a crop of early barley or oats and then black summerfallow. For maximum effectiveness the crop should be cut early for hay.



Showing the amount of root material of quack grass obtained in each case from one cubic foot of fine sandy soil taken from (1) plot of untreated quack grass sod, (2) plot kept black for 19 days, (3) for 73 days, and (4) for 94 days, in a weed eradication experiment using the black summerfallow method (shallow cultivation).—Laboratory of Plant Ecology, University of Saskatchewan, and the National Research Council of Canada.

CHEMICAL CONTROL OF PERENNIAL WEEDS

1. Sodium Chlorate.

Sodium chlorate is a highly inflammable chemical and dangerous to handle in its pure state. It is usually mixed with less inflammable material to reduce danger of handling. The most common preparation containing sodium chlorate is "Atlacide." **Even Atlacide, when dry and mixed with organic matter, is inflammable.** Sparks produced by sweeping it when dry or brushing dry clothing containing sodium chlorate may be sufficient to cause a fire. **All equipment and clothing should be well washed after using a chemical containing sodium chlorate. This chemical can also burn**

the skin and care must be taken to protect the hands and body from undue exposure to it.

Sodium chlorate or Atlacide kills perennial weeds by sterilizing the top soil, usually for at least two or three years. Because of this and its high cost it is usually used only on small patches of perennials.

The following are recommendations for the use of sodium chlorate or Atlacide:

(a) Use a solution of about one pound of chemical to two gallons of water, applying it to the foliage or soil surface.

(b) Apply when weeds are about to flower.

(c) If weed growth is very heavy, cut and rake off and apply the chemical to the soil.

(d) Use the following amounts of chemical per 100 square feet.

Couch or Quack grass	3½ lbs.
Leafy Spurge, Field Bindweed, Russian knapweed, Hoary cress	3½ lbs.
Canada thistle	2½ lbs.
Perennial sow thistle	1¾ lbs.
Poverty weed	1½ lbs.

(e) Best results are usually obtained when the quantities recommended above are divided and used as two applications, about six weeks apart.

(f) Check patches the following year for plants which may have survived.

2. 2,4-Dichlorophenoxyacetic Acid.

While perennial weeds are more resistant to 2,4-D than many annuals, this chemical has shown that it may be of considerable value in perennial weed control. **The following are tentative conclusions** based upon results secured from 1945 to 1947:

(a) The top growth of many important broad leaved perennials may be fairly easily killed by 2,4-D.

(b) In the order of their effectiveness on perennial weeds, the formulations of 2,4-D in common use rank as follows: Esters
Amines
Sodium Salt.

(c) The rates required to seriously damage or weaken the root systems are not less than one pound and preferably 1½ pounds of 2,4-D Acid Equivalent per acre.

(d) Applications are most effective on the root system if applied at the bud or early flowering stage.

(e) Indications are that stands of Perennial Sow Thistle, Canada Thistle and Field Bindweed can be greatly reduced by 2,4,D.

For more detailed information, write for the pamphlet "2,4-D Agricultural Uses in Saskatchewan" prepared by the Saskatchewan Advisory Weed Council and available from the University of Saskatchewan, Dominion Experimental Stations or your Agricultural Representative.

SPECIAL CONTROL MEASURES FOR SPECIFIC PERENNIALS

1. Canada and Perennial Sow Thistle.

Black summerfallowing as described previously is very effective against these weeds.

Tillage in the fall, immediately after the grain is cut, is especially effective against Perennial Sow Thistle. If this is followed by further surface cultivation to kill young plants as they appear, stands of both Canada and Perennial Sow Thistle can be considerably weakened.

A heavy stand of crested wheat, where this grass is adapted, will usually completely eradicate Perennial Sow Thistle in three years and Canada Thistle in four years. Mixtures of grasses and alfalfa will also control stands of these weeds.

Close pasturing, especially by sheep, followed by the black summerfallow is very effective against Perennial Sow Thistle.

2. Couch Grass (Quack, Twitch, etc.).

Black summerfallowing as described previously, is very effective against Couch Grass.

Many infestations of Couch are on light land and therefore, the soil drifting hazard may require some modification of the black fallow. One way this may be done is to carry the program on a strip basis with every other strip receiving the treatment the first year. The following year these strips would be seeded to crop and the alternate strips black fallowed. Some overlapping of strips is necessary the second year to kill rootstocks that have grown beyond the edge of the strips cultivated the first year.

3. Poverty Weed.

There is no known cultural method by which this weed can be completely eradicated in less than two or three years. However, profitable grain crops can be grown by summerfallowing every other year. A three year rotation is not satisfactory because the stubble crop cannot compete with the weed.

Hoary Cress

This weed is easily killed by sodium chlorate.

4. Leafy Spurge, Hoary Cress, Russian Knapweed, Field Bindweed.

Leafy Spurge, Hoary Cress, Russian Knapweed and Field Bindweed are extremely persistent perennials. These weeds may be found in most districts, generally as yet, in comparatively small patches. They are dangerous weeds. They possess deep, woody roots which cannot be eradicated by a full year of black summerfallow and in some cases have survived two years of black summerfallow. Crested wheat grass will not eradicate them. Leafy Spurge has driven some farmers off their land in areas of Western Manitoba.

Because they are such a serious threat to agricultural land, they should be eradicated wherever found. Most of the patches are still fairly small and delay will only result in a more expensive job later on. While some methods of control have been used successfully, those that should be adopted will vary. Successful control or eradication may depend upon such factors as the size of the infestation, the topography or accessibility of the land, and the kind of soil.

It is recommended that when infestations of these weeds are found, they be reported to the Agricultural Representative for the area, and that he be consulted concerning suitable methods for control or eradication.

5. Toad Flax.

Over most of the province Toad Flax ranks somewhere between Perennial Sow Thistle and Canada Thistle in difficulty of eradication. That is, Toad Flax can usually be eradicated by one season of black fallow or in about three years by crested wheat grass.

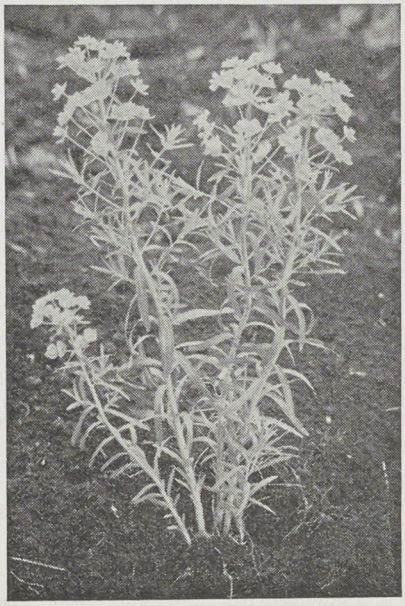
However, in some areas of North Western Saskatchewan, Toad Flax has proven extremely troublesome. In these areas Toad Flax appears to rank with such perennials as Leafy Spurge and Russian Knapweed. The Agricultural Representative should be consulted as to suggested control or eradication measures.

6. Dandelion.

The Dandelion is a troublesome perennial in some areas of the province. It differs from other perennials in that it has a tap root and no creeping rootstocks. For this reason its control is not as difficult as in the case of perennials discussed previously.

Deep plowing may assist in controlling the Dandelion, particularly if the plough slice is allowed to dry out..

2,4-D applied at 1 lb. of acid per acre in the ester form or 1¼-1½ lbs. in the amine form is effective against the dandelion.



Leafy Spurge

PLANT DISEASES

Destructive diseases occur occasionally in all crop plants. When cereals are grown extensively over large areas, as on the prairies of Western Canada, widespread epidemics are favored. Stem rusts of cereals have been very destructive, although this group of diseases is now largely controlled by resistant varieties. However, large losses to the individual farmer, and to the country as a whole, are suffered each year from rootrots, smuts, leaf rusts, leaf spots and other cereal, forage, and vegetable diseases. Market values as well as yields are reduced by diseases.

Much progress has been made by the plant pathologist and plant breeder in finding disease resistant plants. This resistance is combined in new varieties with other desirable characters such as high yielding ability and high quality. However, a great deal remains to be accomplished. Meanwhile many diseases can be controlled by crop rotations, seed treatment, destruction of diseased crop residues, sprays and the use of disease-free seed. Good growing conditions and high soil fertility are of direct value in the control of some diseases.

RUSTS

The different cereal rusts in Saskatchewan are stem rust, leaf rust of wheat, crown rust of oats, leaf rust of barley and leaf rust of rye. The most effective means of controlling them is to grow resistant varieties, but varieties which are resistant to one rust are not necessarily resistant to another. Thus the stem rust fungus consists of several varieties which may attack one or more cereals and certain grasses, and each of these varieties is made up of physiologic races which differ in their ability to attack cereal varieties. For a cereal variety to be successfully grown on the prairies it must be at least highly resistant to the physiologic races of the various rusts found in these regions.

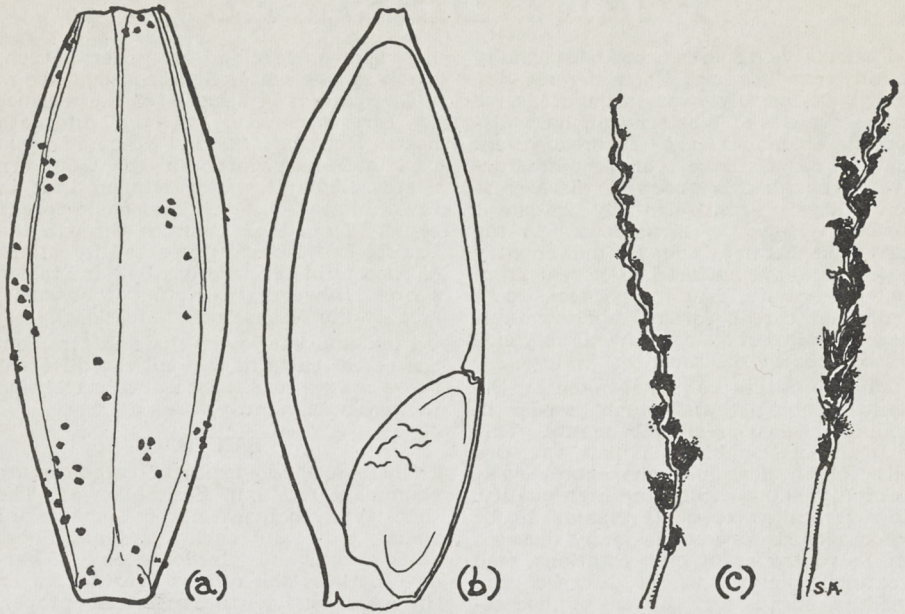
There are many spore stages in the rust fungi, and their life histories are complex. The red summer spores of the rusts serve to spread the disease. Successive generations of these red spores may be produced every 10 days to two weeks and cause reinfections of the grain crops. The red spores of stem rust are killed by our winters, but the red spores of the leaf rusts are able to survive the winters and infect susceptible plants the following year. As the plants mature the black or overwintering spores develop. In general these black spores are of little consequence in Western Canada because of the absence or rare occurrence of the alternate hosts. However, the red stage of stem rust can overwinter in the Southern States. Thus it might happen that in favorable seasons stem rust could spread rapidly from these sources through the Prairie Provinces by repeated infections of susceptible grain crops by wind blown spores. However, with the other rusts, usually the disease originates locally.

Flax and sunflower rusts differ from the cereal rusts in that all the different spore stages are passed successively on the one host plant.

SMUTS

There are two types of cereal smuts commonly found in Saskatchewan. The first type includes covered smuts of wheat, oats, and barley and also loose smut of oats and false loose smut of barley. In these the fungus overwinters on the seed outside the seed-coat proper. Treating the seed with mercury dusts, such as Ceresan and Leytosan, controls these diseases. The second type includes loose smut of wheat and true loose smut of barley. In these the fungus is established in the embryo of the seed and cannot be reached by surface disinfectants. The hot water treatment will control these diseases but it is difficult to apply.

Certain of our recommended varieties are fairly resistant to the smuts (See page 36) and the use of these helps to reduce the prevalence of these diseases. When it is preferable to grow susceptible varieties, they should be carefully examined for smut each year and if there is the least indication of any smut being present, the seed should be treated. Pathologists of the three Prairie Provinces are agreed in recommending that all wheat seed be treated unless it has been examined by accepted methods and found to be sound, healthy, and free from surface-borne smut. In the case of oats and barley, it is recommended that all seed be treated so long as smuts in these grains appear to be prevalent and on the increase. When samples are taken for a seed examination, such as the smut test, it is important to get a representative sample (10 or 12 small samples from various parts of the seed lot to make a total sample of about one half pound) of the seed lot, otherwise the results of the



False loose smut and true loose smut of barley. The spores of false loose smut are carried on the surface of the seed (a) and are destroyed by ordinary treatments. In true loose smut the fungus is in the embryo (b) and the hot-water treatment is needed for control. Both smuts are of similar appearance in the field. In (c) smutted heads representative of either false or true loose smut are shown.

test may be misleading. Care should be taken to see that clean seed does not become contaminated by being run through seed cleaners or by being placed in bags, boxes or bins which contain smut spores. Such containers can be disinfected with a strong solution of formalin. If treatment is necessary, a mercury dust is recommended rather than formalin because it gives excellent control and does not hinder germination of the seed. Also it can be applied in the slack season before the spring rush begins. The dust should be applied with an efficient machine and wheat should be left at least 24 hours and oats and barley at least one week after treatment before seeding the grain.

Mercury dusts are poisonous and must be used with great care. A mask should be worn over the nose and mouth while treating the grain and the machine should be placed so that a breeze will carry the dust away from the operator. After treating grain with these dusts, the operator should wash his hands and face thoroughly and brush the dust from his clothes. Treated seed which is left over should be sown for green feed or else stored very carefully because of its poisonous nature. Under dry conditions the treated seed can be stored for a year. **Formalin also is poisonous but the chief danger from it is injury to the seed.** Use the exact proportions of formaldehyde and water specified and see that the proper amount of grain is treated with a given amount of solution. If possible avoid excessive drying of the seed after treatment. Observance of these precautions will reduce the amount of damage resulting from the use of formalin treatment.

In general it is best to get rid of the true loose smuts by changing to clean seed. The hot water treatment can be applied to small lots of valuable seed any place where the proper facilities are available. The main facilities needed are wire baskets to hold the grain, a tank in which the water is heated with live steam, and an accurate thermometer. Care must be taken to follow instructions exactly as to temperature of the hot water bath and length of time in the bath, to secure good results.

ROOTROTS

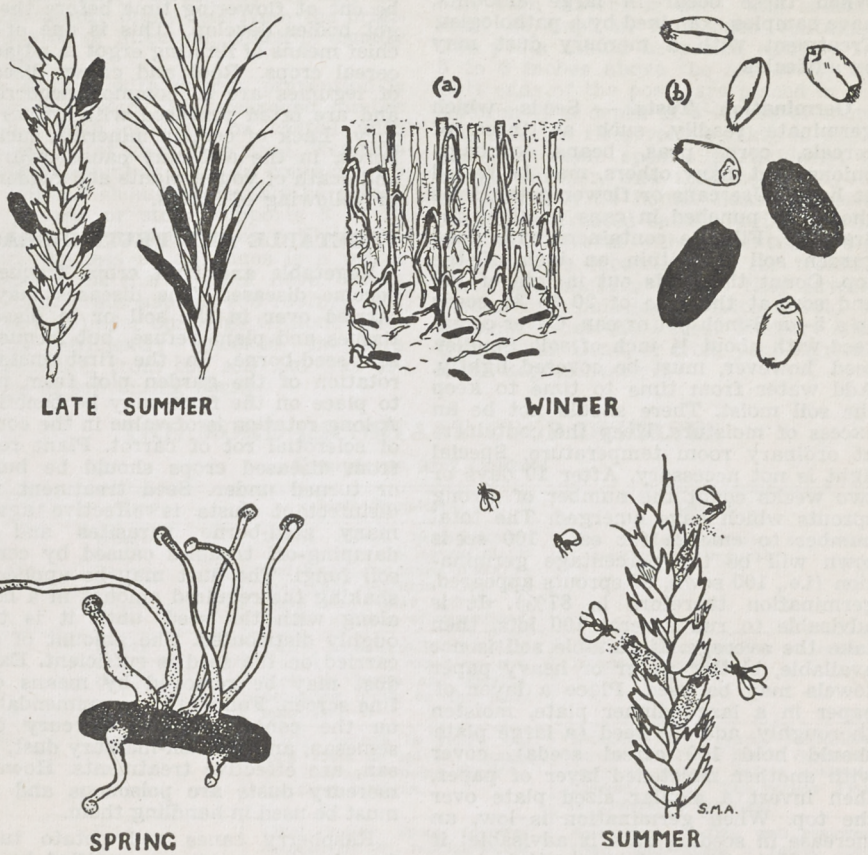
Three well-known rootrot diseases are commonly found in cereal crops in Saskatchewan. **Common rootrot** is widespread in its occurrence and affects all

the cereals and many grasses. **Browning rootrot** occurs chiefly in summerfallow crops of wheat, and less commonly on the other cereals and grasses, probably because they are less frequently grown on summerfallowed land. **Take-all** is seldom important except in wheat on new land in park or wooded areas. Barley, rye, and certain grasses are sometimes attacked. More than one rootrot may occur on the same plant. Frequently injury due to alkali, drought, soil drifting, wireworms or wheat stem maggot is mistaken for rootrot damage, and conversely, rootrots may be mistaken for other troubles.

Recommended varieties of wheat have considerable resistance to rootrots. Since the rootrot fungi are mainly carried over winter in the field, control must lie chiefly in the management of the soil. Sound farming practices in general are recommended. Thus, crop rotation, phosphatic fertilizers, sound seed, early seeding, a firm seed-bed, and weed control all produce beneficial effects in the crop plants, enabling them to withstand attacks by the rootrot fungi.

SEED TROUBLES

Seed should be sound in addition to being pure as to variety and free from weed seeds. By sound seed is meant seed capable of a high percentage of germination, and relatively free from mechanical injury and disease-producing fungi. **Before it is sown, seed should be tested for germination and examined for disease.** Official tests for germination and purity can be obtained at the seed laboratory of the Plant Products Division, Dominion Department of Agriculture,



Ergot of cereals and grasses. In **late summer** the ergot bodies (sclerotia) are very noticeable in the affected heads. The sclerotia pass the **winter** on the ground (a), where some fall at harvest time, or with the seed (b), where they are carried as the grain is threshed. The first infections the following **spring** or early **summer** (June) come from spores produced by the germinating sclerotia; these first infections affect the flower, where an oozing mass of tiny secondary spores appears. Flies are attracted by the ooze (honey-dew) and serve to spread the disease. Later this phase of the infection is replaced by the hard, purple-black ergot body, completing the cycle.

Saskatoon. Arrangements also may be made for routine germination tests through most elevator companies. Germination tests may also be made at home (See below). An examination for the presence of most smuts, certain other fungi, and seed injuries can be obtained from commercial seed-testing laboratories. Sound, disease-free seed may be sown without treatment. **However, seed treatment should not be neglected unless the seed has been properly tested and found satisfactory.** Further information on how and where to send seed samples may be obtained from agricultural representatives, elevator agents, and other sources.

Wheat seed samples may show injury caused by molds, heating, Russian thistle stain, and weathering. Several other blemishes are seen occasionally. When these occur in large amounts, have samples examined by a pathologist. Treatment with a mercury dust may be advisable.

Germination Tests. — Seeds which germinate readily, such as those of cereals, corn, peas, beans, cabbage, onions, and many others, may be tested at home. Use cans or flower pots. Holes should be punched in cans to allow for drainage. Fill the containers with good garden soil to within an inch of the top. Count the seeds out in lots of 100 and sow at the rate of 20 to 30 seeds to a 5- or 6-inch pot or can. Cover cereal seed with about ½ inch of soil. Smaller seed, however, must be covered lightly. Add water from time to time to keep the soil moist. There should not be an excess of moisture. Keep the containers at ordinary room temperature. Special light is not necessary. After 10 days or two weeks count the number of strong sprouts which have emerged. The total number to emerge for each 100 seeds sown will be the percentage germination (i.e., 100 sown, 87 sprouts appeared, germination therefore is 87%). It is advisable to run several 100 lots, then take the average. If suitable soil is not available, blotter paper or heavy paper towels may be used. Place a layer of paper in a large dinner plate, moisten thoroughly, add the seed (a large plate should hold 100 cereal seeds), cover with another moistened layer of paper, then invert a similar sized plate over the top. When germination is low, an increase in seeding rate is advisable; if below 65%, the seed is unsatisfactory. General precautions and advice mentioned above should be followed. Cereal seeds sometimes do not germinate well until about December. If difficulties are encountered, it would be advisable to send a sample to a properly equipped laboratory for testing.

FORAGE CROP DISEASES

Many diseases of grasses are identical with or similar to diseases of cereal crops, and may be handled in like manner (see table, page 85). Rootrots are probably the most important group of diseases of forage crops. Grasses harbor the rootrots of cereals, and besides tending to increase the infestation of the soil by the rootrot fungi they frequently suffer considerable damage themselves. Grasses are definitely more susceptible to pre-emergence killing and early seedling blights than the cereals. Many grasses, both wild and cultivated, are susceptible to ergot and, as ergot is poisonous to animals, grass hays should be cut at flowering time before the ergot bodies develop. This is one of the chief means of limiting ergot in adjacent cereal crops. Root and crown diseases of legumes are of common occurrence and are often confused with winter injury. Lack of certain minerals, such as boron, in the soil may cause dwarfing and death of young plants and reddening or yellowing of leaves.

VEGETABLE AND FRUIT DISEASES

Vegetable and fruit crops frequently become diseased. The diseases may be carried over in the soil or in diseased tissues and plant refuse, but frequently are seed-borne. In the first instance, rotation of the garden plot from place to place on the farm may be beneficial. A long rotation is of value in the control of sclerotial rot of carrot. Plant refuse from diseased crops should be burned or turned under. Seed treatment with disinfectant dusts is effective against many seed-borne parasites and the damping-off troubles caused by certain soil fungi. The dust may be applied by shaking the required amount in a bottle along with the seed, until it is thoroughly distributed. The amount of dust carried on the seed is sufficient. Excess dust may be removed by means of a fine screen. Follow the recommendations on the container. The mercury dust, semesan, and the non-mercury dust, arasan, are effective treatments. However, **mercury dusts are poisonous** and care must be used in handling them.

Raspberry canes and potato tubers for planting purposes, certified by Dominion Government inspectors to be relatively free from virus and other diseases, are available on the market. Thus,

"run-out" raspberries or potatoes should be replaced by healthy stocks.

Many potato, vegetable, and fruit diseases are spread by insects. Some of these are spread in this manner only. In such cases, prevalence of the disease is a reflection of the abundance of the insect carrier and control of the disease is dependent upon the control of the insect.

For a discussion of storage problems, see the section on Horticulture, page 60.

DRYROT OF BASEMENT TIMBERS AND FENCE POSTS

Dryrot of sills, joists, and other basement structures is caused by a fungus. It shows as a dry decay of the wood, often accompanied by a cream-colored, papery, flaky fungus growth, with sometimes roughened, rusty brown spore-producing areas. The rot may advance rapidly many feet from the original source of infection, which is usually the soil.

In dealing with dryrot, prevention is better than cure. Well-seasoned lumber treated with creosote or coated with creosote paint should be used. Nowhere should the lumber come in contact with the soil but should preferably be placed on concrete or stone supports 8 to 12 inches above ground. Good ventilation to ensure dryness at all times is a prime necessity. Extensive tests have shown that high-grade asphalt roll roofing, laid on the soil under buildings without basements, efficiently checked moisture condensation from the soil and was effective in preventing decay.

After the rot has appeared, treating the surface with a disinfectant is of little use. However, if treatment is undertaken all trace of the rot should be cut out well beyond the last signs of decay, all chips of rotted wood removed and exposed surfaces and nearby wood disinfected. For disinfection use formalin solution (1 lb. of formalin in 15 gallons of water) or copper sulphate solution (1 lb. copper sulphate in 5 gallons of water).

Woodrots are the main cause of fence post decay as well as the deterioration of storage cellar timbers. The durability of posts may be increased many years by proper treatment. Green pickets and fence posts, particularly poplar, may be easily treated with bluestone (copper sulphate) solution. A saturated solution (2½ lbs. to each gallon of water, preferably rain water) is used. The solution must be kept in a wooden container. The posts should be peeled entirely for 5 to 6 inches above the soil level. The butt ends of the posts are placed in the solution to a depth of 6 inches or more. The solution rises very quickly in green posts, of some species particularly, in warm weather, and treatment may be completed in 12 hours. Seasoned posts cannot be treated satisfactorily by this method. Several other mixtures and methods are recommended for treating posts and timbers but as they involve special manipulations, advice should be obtained from the Forest Nursery Station, Indian Head, or from your Agricultural Representative.

THE MORE IMPORTANT CROP DISEASES

Symptoms and Control

Disease	Crop	Main Symptoms	Control
Stem rust	Wheat Oats Barley Rye Grasses	Dusty, raised, reddish-brown oblong spots on leaves, stems and heads, becoming black as the plant matures. The red spore dust may adhere to hands, clothing or machinery.	Use resistant varieties as recommended (see page 36).
Leaf rust	Wheat Barley Rye	Dusty, raised, yellow to light orange, small, round to oval spots on leaves and sheaths, becoming black as the plant matures.	Use resistant varieties as recommended (see page 36).
Crown rust	Oats	Dusty, orange to yellow oblong spots on leaves, sheaths and heads, becoming black as the plant matures.	Eradicate any nearby buckthorn shrubs (alternate host). Sow oats early to mature before epidemic becomes severe. The variety Ajax is moderately resistant.
Rust	Flax	Light yellow spots followed successively by reddish-yellow and reddish-brown to black spots on leaves, stems and flower parts.	Sow crops of flax well removed from land where a rusted crop had grown the previous year. Plow down rusted flax refuse by early June. Clean seed to remove bits of rusted straw. Use resistant varieties as recommended (see page 42).

Disease	Crop	Main Symptoms	Control
Rust	Sunflower	Dark brown rust spots on leaves, especially the lower ones. Leaves fall in severe cases.	Rotate crops and plow down or burn litter from rusted crop. Keep down volunteer seedlings.
Bunt (covered or stinking smut)	Wheat	Bunt balls are produced in place of kernels; not conspicuous in the field; best seen in threshed grain where brush end is darkened; unbroken bunt balls may be found in seed; usually an unpleasant odor is present.	Use resistant varieties where suitable. Clean the seed well before treatment. Use a mercury dust at the rate of one-half ounce per bushel. Use a proper machine for applying the dust and treat at least **1 day before sowing (1 week in the case of oats and barley).** The mercury dusts may be used as a wet treatment if preferred. Mix 1 part of dust to 800 parts of water by weight (8 ounces to 40 gallons). Dip the seed for 5 minutes and then drain and dry. Formalin, properly applied, will control these smuts, but it may injure the seed. For the sprinkle method, use 1 pound of formalin to 30 gallons of water. This amount will treat about 40 bushels. Treat with a seed grain pickler or sprinkle it on the grain while turning it over with a shovel. Cover with sacks for 4 hours and then spread out to dry overnight.
Covered smut	Barley	Heads are dull greyish color. Often remain in the boot under dry conditions. Spikelets, except awns, become masses of purple-black spores covered rather permanently by a thin membrane. Clumps of smut are conspicuous in the grain.	
False loose smut	Barley	The spikelets and flowers are destroyed and replaced by loose powdery smut masses which break up and blow away during flowering time. Smut masses resemble those of true loose smut except that they are darker in color.	
Covered and loose smut	Oats	Dark brown spore masses take the place of spikelets. They may be of the covered or loose type and intermediate forms.	Do not treat hulless oats with formalin. Small quantities of solution may be made by adding 1 tablespoonful of formalin to 1 gallon of water.
Head smut and kernel smut	Hog and Foxtail millet	In the head smut of hog millet, the entire panicle is involved causing distortion. In kernel smut of the foxtail type the individual flowers are involved, the panicle being normal in shape. Smut is noticeable in the seed in both cases when severe. Smutty hay may be somewhat toxic to animals.	Both smuts can be controlled by a mercury dust or formalin sprinkle treatment as outlined under bunt of wheat above.
Head smut	Cultivated grasses	Loose type of head smut, spikelets changed to powdery black masses of spores. Plants once infected will produce smutted heads year after year.	Treat seed with mercury dust as for bunt of wheat.
Smut	Corn	Galls of various sizes at first covered by a white to grey membrane, occur on above-ground parts.	Rotate crops. Pick into a paper bag and burn smut galls as soon as they appear, to reduce infestation of the soil.
Loose smut	Wheat	The heads become conspicuous black, dusty masses of spores which blow away leaving the bare stem. Not evident in threshed grain.	Dispose of contaminated grain for feed and get registered or certified seed. Or plant an isolated seed plot and pick the smutted heads, as soon as they appear, into paper bags and burn both bags and smut.
Loose smut	Barley	The grain is completely destroyed. The brown spore mass is covered with a fine membrane at first which soon breaks up. The spores are then blown away by the wind. The color of the spore mass is not so dark as that of false loose smut.	Or, for small lots of valuable seed, apply the hot water treatment using the following schedule: soak in cool water for 6 hours, place in wire baskets or loose bags and dip for 11 minutes in water held at 129° F. (125° to 126° F. for barley), take out and cool immediately in cold water, and spread the seed out in a clean place to dry for several days before seeding. Rogue out smutted heads if any in the subsequent crop, as they appear.

Disease	Crop	Main Symptoms	Control
Common rootrot	Wheat Oats Barley Rye Grasses	Brown discoloration of stem bases, roots, crown, and lower leaf sheaths. Reduced height, fewer stems and grains per head. Sometimes plants bleach, die and occasionally break over before maturity.	No specific control method is known. Good farming practices are beneficial, such as, sow sound seed early in a firm seed-bed, and maintain soil fertility. See smudge below for seed treatment.
Browning rootrot	Wheat Oats Barley Millet Grasses	Large brown areas in crops mainly on summerfallowed land in June. This appearance is caused by extensive browning and dying of the lower leaves. The tips of the crown roots are rotted. Stooling is reduced, seedlings stunted, maturity delayed and yields lowered.	Use phosphatic fertilizers. Maintain soil fertility. Sow seed in a firm seed-bed. In some districts injury has been less severe where weed growth has been plowed down in early July of the summerfallow year, or where partial summerfallow has been used. Grasses sown in June may be severely injured.
Take-all rootrot	Wheat Barley Grasses	Frequently occurs in scattered plants or in patches in the black soil zone on second and successive wheat crops after breaking. Plants are stunted and bleached. The roots are blackened and brittle. Plants often die prematurely and produce shrivelled grain.	After breaking native or cultivated sod use a rotation such as wheat, oats, wheat, fallow, followed by any good rotation. Maintain soil fertility.
Ergot	Grasses Rye Barley Wheat Oats	Conspicuous horn-like purple to black fungus bodies produced in place of seeds, present in threshed grain. **Poisonous to man and animals.**	Cut all nearby grasses before or when they come into head as they are the chief source of infection. Remove ergot from the seed with suitable cleaning machinery. Plow deeply, at least 4 inches, to bury ergot bodies that have fallen to the ground.
Various spotting and discolorations of leaves, stems, heads, and seed	Wheat Barley Oats Rye	Conspicuous light or dark spots, separate or joined. Seed may be shrunken or discolored. Occasionally bacterial ooze present.	Seed from such crops should be examined by a pathologist. Treatment with a mercury dust as outlined under smut control, after thorough cleaning, may be necessary.
Smudge (Black-point)	Wheat Barley	Light to dark brown discolorations usually at the embryo end but may spread somewhat over the kernel.	Seed should be examined by a pathologist to determine the cause. If parasitic, then treatment with a mercury dust is advisable.
Bacterial black-point (Basal glume-rot)	Wheat	An inky black point at the embryo tip.	Seed should be examined by a pathologist. A mercury dust treatment may help, but there is no evidence that it is generally advisable.
Scab (Fusarium blight)	Wheat Barley Oats Rye	Bleaching and shrivelling of head or spikelet and seed, with a pinkish fungus growth mostly at the base of the spikelet in wheat, barley, and rye. Scab (Fusarium) infested feeds are poisonous to hogs, dogs and man.	Seed should be examined by a pathologist. Clean thoroughly and treat with a mercury dust as for smut control.
Stripe	Barley	Long, brownish stripes on leaves and sheaths, which become shredded. Plants are stunted, usually failing to head out.	Sow seed from disease-free fields or treat seed from infested crops with an organic mercury dust as outlined for bunt of wheat.
Halo blight	Oats	Spots or blotches on leaves and sheaths with dead central portions surrounded by yellowish-green margins, giving a halo effect.	Partial control may be obtained by use of mercury dust treatments as outlined for bunt of wheat. The varieties Ajax and Exeter appear to have some resistance.
Thin or shrunken seed	Wheat Oats Barley	Light, shrivelled seed caused by rust, rootrot or drought.	Remove the lighter seed with a fanning mill. Avoid deep seeding. Mercury dust treatment is advised. Normal rates of seeding are usually satisfactory.

Disease	Crop	Main Symptoms	Control
Frost injury in cereal and flax seed	Wheat	Immature greenish kernels and distinct transverse wrinkling of the seed coats of the larger kernels.	After cleaning, a germination test must be made to determine the extent of injury. If suitable for seeding, a mercury dust treatment may improve the stand. An increase in seeding rate may also be advisable.
	Oats	Frequently indicated by a whitening and looseness of the hulls.	
	Barley	No conspicuous symptoms.	
	Flax	Immature shrivelled white seed or seed of maroon or dark green color.	
Piebald or yellow-berry	Wheat seed	A starchy condition of the endosperm giving the kernels a yellow appearance wholly or in part, caused by nitrogen deficiency. Embryo unaffected.	Use ammonium sulphate or 16-20 ammonium phosphate fertilizers. Increase soil nitrogen by growing legume.
Blast (non-parasitic)	Oats	Conspicuous white sterile spikelets, usually the lower ones.	No specific recommendations are known.
Seed decay and seedling blight	Flax	Flax seeds may rot or seedlings fail to emerge. Seedlings 1 to 4 inches high wilt, fall over, and die. Thin stands frequently result. Note: This trouble should not be confused with damage from frost or early heat canker.	Sow **sound,** clean seed treated with organic mercury dusts, 1½ oz. of dust per bushel of seed. Rotate crops. Sow in a firm seed bed.
Stem break and browning	Flax	The stem-break stage is recognized as a breaking over of the plants about 1 inch above ground level. Later, light brown spots appear on leaves, stems and seed bolls. In severe cases diseased areas may have a brown cast. Infected seed is scaly.	Rotate crop. Clean seed and treat with mercury dusts at 1½ oz. per bushel. Destroy diseased refuse before the new flax crop emerges.
Pasmo	Flax	Irregular brown spots on leaves. Large brown spots on stems often alternating with bands of uninfected green portions. Occurs late in the season.	
Wilt	Flax	Plants may wilt and die at any time from the seedling stage on. Others stop growth, turn yellow or greyish and remain unthrifty. Tops of plants are frequently hooked.	Grow wilt-resistant varieties such as Dakota, Redwing and Royal, and use long rotations. Treat seed with mercury dusts.
Rootrot	Flax	Slight stunting with premature ripening of the plant and shrivelling of the seed. Wilt-resistant varieties may be attacked.	No specific control measure is known. Good flax-growing practices offer the best protection from the disease.
Die-back and scorch	Flax	The top third or, less commonly, the whole plant turns brown following hot, dry weather during ripening; the grain usually lacks plumpness.	Early seeding might help the crop to mature earlier and thus escape the heat damage of late summer.
Heat canker	Flax	Seedlings are girdled at ground level, collapse and die. Partially affected plants often continue to grow and may eventually break over at ground level.	Early and thicker seeding. Sow in a north and south direction.
Crown rot	Alfalfa Clovers Grasses	Dark decayed areas on crowns and upper parts of roots. Remainder of roots sound. Plants killed singly or in patches when snow is melting. Should not be confused with winter killing.	Crop rotation; do not reseed with alfalfa for at least two years. Seed down new fields every 2 years or so. Avoid late fall cutting, grazing and burning. Resistant varieties are being developed.

Disease	Crop	Main Symptoms	Control
Bacterial wilt	Alfalfa	Plants reduced in vigor, the leaves turn yellow and bleach, and the plants turn brown and die in late summer. Leaflets small, stems small and more numerous than on healthy plants. Outer woody tissue of tap root pale-brown in color. On scattered plants or on groups of plants.	Use a short crop rotation. Clovers and grasses are not susceptible. Ladak is partially resistant.
Root rots	Alfalfa Clovers Grasses	Plants turn yellow and die, singly or in patches. Rotted areas on crown and roots. Diseases occur throughout growing season.	Crop rotation, including fallow and cereals.
Seedling blight	Clovers Grasses	Seed rotting and death of seedlings before or after they emerge, causing thin stands.	Seed treatment with mercury dusts or Arasan is helpful, but cannot be used where seed is being inoculated.
Cold and winter injury	Alfalfa Clovers Grasses	Plants die singly or in patches in early spring. Roots rotted and shredded.	Use adapted varieties. Avoid late pasturing and cutting. Snow plowing and snow fencing on exposed areas helps to prevent drying out and erosion by wind.
Black stem	Alfalfa Sweet clover	At first, small brown to black spots on stems and leaves which enlarge and join, often extending around the stem and into the crown. Stems may have a scorched appearance. Heavily infected leaves drop off.	Destroy old stubble and leaf trash by early spring burning. Cut hay crop early.
Leaf spots	Alfalfa Clovers Grasses	White, yellow, and brown, round and irregular spots. Cause defoliation where severe.	Destroy old stubble and leaf trash by early spring burning. Cut hay crop early.
Snow mould	Grass crops, lawns, golf greens and winter cereals	Conspicuous white fungus growth overrunning leaves and crown tissues, causing dead patches in crop or turf. Occurs in spring frequently under or near melting snow.	Crop rotation and sanitation may help for cultivated grasses and cereals. For lawns and golf greens apply, in the fall, 4 ounces of a mixture of equal parts of calomel and mercuric chloride per 1000 square feet. The mixture should be mixed with enough dry sand to assure an even distribution. Teresan, a commercial product, may be applied in the fall as a spray at the rate of 6 to 8 ounces per 1000 square feet.
Bacterial ring rot	Potatoes	Rolling, wilting, yellowing of leaflets on single stems, light brown cheesy rot of the vascular ring in tubers.	This disease is highly infectious and suspected tubers should not be distributed for seed. (They may be used for food.) Disinfect tools, bags, and machinery with 1 pound formalin to 25 gallons water. Disinfect storage house with whitewash containing 1 pound copper sulphate in 10 gallons. To sterilize cutting knives, dip them in 5% solution of lysol (3 teaspoonfuls to 1 cup of water). Obtain certified seed for the next season.
Blackleg	Potatoes	Stunting, yellowing, reduced and erect branching, rotting and blackening of base of stem, easily pulled, soft rot at the stem end in the tubers.	In severe cases use disease-free or certified seed stock. Discard rotted tubers and disinfect cutting knife with lysol solution frequently and especially after cutting a rotted tuber. Remove infected plants and tubers from the field and destroy. Rotate crops.
Wilts	Potatoes	Severe wilting, stunting and premature ripening of the plant. Brown ring frequently seen when the tubers are cut.	Do not plant potatoes on the same soil oftener than once in four years. Discard tubers for seed purposes if they have internal discoloration. Use certified seed.

Disease	Crop	Main Symptoms	Control
Black scurf (Rhizoctonia)	Potatoes	Small black fungus bodies adhere to the tubers. Sprouts may be killed, base of stem may be girdled, causing formation of aerial tubers.	Select seed free from black scurf and delay planting if soil is cold and wet. Use a long rotation of crops and avoid old garden soils. Dig potatoes intended for seed before the crops have completely ripened down.
Scab	Potatoes	Distinct, irregular, rough, corky spots on tubers.	Select disease-free seed. Use a long rotation and avoid freshly manured land. Scab is generally less where potatoes follow sweet clover. Netted Gem is resistant but is not suited to dry prairie conditions.
Viruses	Potatoes	Leaf and stem abnormalities such as mottling, crinkling, necrosis, purple coloration and leaf rolling, also spindle shaped tubers and stunting of the plants.	Use certified seed. Remove diseased plants, including the tubers, from crop intended for seed. (These tubers may be used for food.) (See notes page 61.)
Yellows (virus)	Carrots	Outer, older leaves reddish or purple. Younger central leaves dwarfed, distorted, yellowish and frequently very numerous. Numerous branched rootlets growing out from the carrot root.	This disease is transmitted by a small green leafhopper. No specific recommendations are known.
Bacterial blights	Beans	Leaves show water-soaked spots becoming brown and brittle. Pod spots are water-soaked, later becoming sunken and amber yellow in color, and reddish around the margins. Yellowish spots occur on the seed.	Rotate crops. Use seed from a disease-free crop. Discard discolored seed. Do not sow thickly and cultivate only when dry. Varieties of the Refugee type, known to be somewhat resistant.
Rootrot	Peas Sweet peas	Reddish-brown decay of base of stem and root. Plants easily pulled up.	Rotate crops and destroy refuse from diseased crop. Obtain disease-free seed. Ceresan at 1 ounce or Arasan at 1¼ ounce per bushel are recommended treatments. Seed treatment is not entirely successful for leaf and pod spot. Note: Seed treated with a nodule culture should not be treated with these dusts.
Leaf and pod spot	Peas	Definite, sunken, tan to brown spots, circular on leaves and pods, oval to long on stems, surrounded by a brown margin.	
Powdery mildews	Peas Clover Raspberry Gooseberry etc.	Gray to white powdery spots on leaves and stems.	May be checked by frequent dusting with sulphur. For small gardens, place the dust in a cotton bag and shake gently over the plants. Clean up refuse in the fall.
Wilt	Sunflower	Wilt of leaves, decay of roots, cankers form at the base of stem, and hard black fungus bodies (sclerotia) may occur in or on diseased tissues. Heads and seeds may be affected occasionally.	Rotate with cereal and grass crops. Use clean seed.
Fire blight	Apple Crabapple Saskatoon berry Mountain ash Hawthorne	A fire blight effect is produced when blossoms, fruits, leaves and twigs wilt and turn brown, remaining on the tree. Cankers usually develop in the bark on twigs, limbs, and trunks.	In the case of crabapples, use the resistant varieties. Prune out all cankers while trees are dormant. Remove blighted twigs as they appear. Severely diseased trees, cultivated or wild, should be removed.

ENQUIRIES

Enquiries regarding plant diseases will be welcomed, and detailed recommendations will be sent on request. Wherever possible, send in specimens along with a brief history of the trouble. With the exception of firm fruits, tubers, and roots, most specimens should be dried before mailing. Enquiries may be addressed to the Dominion Laboratory of Plant Pathology, or the Department of Biology, both at the University of Saskatchewan, Saskatoon, Sask.

INSECT PESTS
OF PLANTS AND LIVESTOCK

FIELD CROP INSECTS

Wireworms, cutworms, grasshoppers and the wheat stem sawfly are the major insect pests of field crops in Saskatchewan. Their control is secured mainly by suitable **adjustments** of common farming practices, without adding extra operations. Proper summerfallowing is of the utmost importance, but insects should be considered in planning every part of the farm program, including seeding and harvesting, the choice of crops and immune or resistant varieties, and reseeding fields where damage has occurred. Special measures may also be required, such as sawfly traps and the use of poisoned baits, dusts or sprays.

RECOGNITION

It is essential to recognize the pests and the symptoms of their damage in order to control them. Those more commonly encountered, and also some other factors often confused with insect damage, may be identified as follows:

A.—Damage to Planted Kernels

1. Kernels bored into, or only germ end destroyed: usually **wireworms** (yellow, hard-bodied worms, see page 92); occasionally **seed maggot** (small, white, soft-bodied, legless maggots).

2. Kernels still whole, not visibly damaged: poor germination in such cases may be caused by poor seed, formalin treatment, undesirable seeding practices, or unfavorable soil conditions.

B.—Damage to Young Plants

1. Leaves and stems partly eaten, sometimes completely devoured: usually **grasshoppers,** see page 94, **beet webworm** sometimes damages flax and alfalfa, see Table 2, page 103; sweet **clover weevil** notches leaves of sweet clover, see Table 1, page 99; **red turnip beetle** damages leaves of rape, see Table 1, page 99; **flea beetles** eat small round holes in leaves of rape, see Table 1, page 99.

2. Plants completely cut off at or near soil surface, tops usually disappearing leaving only stubs under ground: usually **cutworms** (dull-colored, soft-bodied worms, curl up when disturbed, see page 93), note that damage of similar appearance is sometimes caused by a severe infestation of **young grasshoppers,** see page 94.

3. Underground part of stem shredded or bored into, but rarely completely cut off; dead plants usually remain for some time in drill row, typically with centre leaf withering before outer leaves: **wireworms,** see page 92.

4. Central shoot withered, underground parts not attacked: **hessian fly** (tiny, whitish maggots or brown "flax seeds" found between the stem and the base of the leaf).

5. Underground parts not cut off or bored into, discolored with brown or black areas; outer leaves die before central leaf: **rootrots,** see page 82, Plant Disease section.

6. Plants may be killed by wind, drought, frost, gophers, etc.

C.—Damage to Maturing Plants

1. Leaves, stems, heads, or seed pods may be chewed or dropped on the ground by one or more of the following pests: **grasshoppers,** see page 94; **armyworm wheat head armyworm, bertha armyworm, flax bollworm,** see Table 1, page 99; **beet webworm, sunflower beetle,** see Table 2, page 103; **red turnip beetle,** see Table 1, page 99; **flea beetles,** see Table 1, page 99; **black field crickets** may damage flax bolls.

2. Ripe stems of wheat, etc., smoothly cut at soil surface and fall over, stem tunnelled out and full of "sawdust": **wheat stem sawfly,** see page 96.

3. Plants broken over or cut off several inches above ground, in patches, heads eaten: **gophers** (often confused with grasshoppers and sawfly).

4. Stems sharply bent but not chewed: (a) bend occurring most frequently just above the lowest joint: **hessian fly** (tiny maggots or "flax seeds" under leaf sheath between bend and joint); (b) deformed stems may be caused by disease, physiological weakness, wind or hail.

5. Heads empty or containing only shrivelled kernels: (a) plants appear normal but kernels shrivelled, chiefly at field margins: **Say's grain bug,** see Table 1, page 99; (b) wheat heads turn white prematurely while leaves still green, and contain no grain: **wheat stem maggot,** see Table 1, page 99; (c) whole plant ripens prematurely, often stunted, with no signs of chewing: two kind of **rootrots,** see page 82, Plant Disease section; (d) damage by frost or hail sometimes confused with that by insects; where empty heads are caused by hail, numerous small whitish spots show on stems.

6. Tiny green **aphids** may be abundant on plants, especially if summer rainfall is above normal, but damage inconspicuous, see Table 1, page 99.

7. Seed of alfalfa hollowed out, and small hole made when adult emerges: **alfalfa seed chalcid** (tiny, blackwasp).

8. Alfalfa buds wither, giving "white-top" appearance; excessive drop of flowers and small seed pods; discolored and shrunken seeds found before frost occurs: **Lygus and other plant bugs,** see Table 1, page 99.

WIREWORMS

Wireworms are slender, hard-bodied, shiny, yellow worms, the largest about

one inch long. Each year some of the worms reach full growth and change to a pupal or resting stage. The pupae may be found in the top 3 inches of soil during the latter part of July, but they soon change to black "click" beetles which remain underground until the following spring. The beetles lay eggs in the soil from which tiny wireworms hatch in late June and early July.

Wireworms attack all grain crops, especially wheat. They are a pest in all parts of the Province, but are most troublesome in the medium and light soils of the open prairie areas. **The worms live five to ten years,** move very little, and are not easily destroyed. Therefore, once a field becomes infested it usually remains so for many years, although damage may be noticed only to the crop seeded on fallow.

Damage.—Thin, poor stands of crop are typical. In severe cases nearly the whole crop may be eaten out, but with plants still growing in the firmer parts of the field such as headlands and wheel tracks. Wireworms attack the seeds as soon as they are sown. Usually, however, the main injury is to the young plants. The stems are not cut off, but the underground parts are bored into and shredded. With older seedlings it is typical that the central shoot dies first while the outer leaves remain green for some time. Serious damage usually ceases when stooling begins. The damage is most severe to crop seeded on summerfallow or on rebroken grassland; crop seeded in infested stubble land is not usually seriously injured.

CONTROL

Clean summerfallowing is the only practical means of reducing wireworm infestations. However, crops seeded on such fallows normally suffer much heavier damage than crops seeded on stubble, because the wireworms that survive the summerfallowing are very hungry and are more destructive. Weedy fallows, whether unworked or poorly worked, usually do not starve the wireworms and so may not be followed immediately by heavy crop damage, but eventually lead to a dangerous increase of wireworm infestation. These confusing facts have always puzzled farmers. The solution lies in frequent good summerfallowing to keep down the pest numbers, and overcoming the temporarily increased risk of damage on these fallows by using the best seeding methods.

Reduce wireworm infestations by regular clean summerfallowing.—(1) Summerfallow every second or third year where wireworms are bad. (2) Keep the fallow free of weeds, especially volunteer grains and grasses, from the middle of June to the end of July. This

will starve the newly hatched wireworms. (3) Tillage should not be deeper nor more frequent than is necessary for weed control. Either plowing or surface tillage may be used, but the latter is more economical and provides a firmer seed bed. Shallow working in late July destroys some pupae but is not recommended unless also desirable for weed control, such as in land that is to be left untouched during the cutworm egg-laying period.

Prevent wireworm increase by regular use of clean fallow, as outlined above. Wireworms usually increase decidedly where grains or grasses are grown for five or more years in succession. Such increases may occur in any part of the Province.

Reduce damage by means of suitable seeding practices.—(1) Seed into a firm, clean seed bed. (2) Seed into moisture but not deeper than 3 inches. (3) Avoid both very early and very late seeding. (4) Use a well adjusted drill or oneway seeder and an effective packer (see page 25, Farm Machinery section); or use a press drill. (5) Seed the heaviest rate recommended for your district. (6) If treating the seed, use a mercury dust; avoid using formalin. (7) Use a phosphate fertilizer for wheat in districts where it usually produces an increased yield.

These practices assist the crop in escaping wireworm damage by speeding up the germination and early plant growth. They are essential when seeding crop on summerfallow and rebroken grassland where wireworm damage is usually most serious. In such fields seeding into loose, dry soil is almost certain to result in severe damage and should be avoided.

Choice of Crops.—Wheat and spring rye are most susceptible to damage by wireworms. Oats and barley are considerably more resistant, especially if seeded early. Flax may suffer serious damage if planted on heavily infested fallow or rebroken grassland, but has given good results on new breaking. Winter wheat, fall rye, sweet clover, alfalfa, and grasses usually escape serious injury. Corn, potatoes, and sunflowers should not be planted on severely infested land.

Re-seeding immediately of fields in which wireworms have destroyed the crop is usually a safe practice if the above recommendations are followed, and especially if oats or barley is used.

Chemical control of wireworms.—Several chemical soil treatments which will control wireworms have been developed recently. Of these, benzene hexachloride is the most efficient, but the present cost of at least $15 per acre for material alone makes it too expensive for use in grain fields. Its use in gardens is also limited because potatoes and other root crops grown on treated soil, even in the second year after treatment, have been tainted and unsuitable for use. On the basis of experiments now in progress benzene hexachloride seed treatments show considerable promise as a practical means of controlling wireworms in grain fields. Further testing is required before this method can be recommended.

CUTWORMS

Cutworms have fleshy, soft bodies, and when disturbed usually curl up and remain motionless. They destroy plants

by cutting completely through the young stems at or just below the soil surface (contrast with wireworms). All field and garden crops are susceptible. Damage normally takes place from late in May until about the 20th of June. They have an annual life cycle. The parent moths, which are present in late summer, often fly considerable distances before laying their eggs. The fields infested one year are not necessarily the same as were damaged the previous spring.

Only two kinds of cutworms are serious pests in Saskatchewan in the spring. Since these require different methods of control it is important that they be distinguished. The **pale western cutworm** is a uniform pale grey color and is a pest of the open prairie and park margins. The **red-backed cutworm,** however, is moderately dark grey on the upper half of the body and has two

broad, dull-red stripes running along the back. It normally occurs in the park and forest belt but during outbreaks may extend well out into the open prairie area, especially in gardens.

CONTROL OF THE PALE WESTERN CUTWORM

Cultural methods which either prevent or destroy the infestation are the only means of control. Poison baits are not effective since the pale western cutworms do not come to the surface to feed.

Prevent infestation of fields being summerfallowed by leaving them undisturbed from about August 1 to September 15. This permits the soil surface to become crusted by rain. The parent moths, which are present during that period, lay few, if any, eggs in soil that is even slightly crusted. Neither implements nor livestock should be allowed to break this crust. This should be the standard summerfallow practice in cutworm areas. By destroying green growth in late July weeds normally will not be a problem before mid-September.

Destroying infestation by starvation before seeding.—Infestation can be expected in outbreak areas in fields which were disturbed by harvesting or weed-control operations during the moth flight period, or which later received drift soil from such fields. To destroy infestations: (1) Kill all green growth on the fields when weeds (except stinkweed) and volunteer grain seedlings are from 1 to 2 inches high. This is before the field shows a green cover. (2) Seed about 10 days after the tillage has been completed.

This method will starve the very young cutworms if done immediately after they have first fed. It will not be effective if the tillage is done before the seedlings have appeared nor if it is left too late. **"Starvation control"** is recommended for districts where a severe outbreak of pale western cutworms has been forecast.

Reseeding of damaged fields is not safe until the pale western cutworms have ceased to feed. This will be about a week after the majority are 1½ inches long, usually about June 20.

CONTROL OF THE RED-BACKED CUTWORM

Poisoned bran bait is an effective and practical control for the red-backed cutworm.—Scatter the bait (formula 7, page 101) thinly over infested fields about dusk on warm calm evenings. Baiting is more effective if done early in the season when the larvae are small and particularly when the soil surface is slightly damp from recent rains.

To minimize infestations of the red-backed cutworm on fields being summerfallowed, weeds should be destroyed in late July, and the fields left undisturbed throughout August unless a heavy weed growth develops.

Reseeding of damaged fields can be undertaken as soon as the red-backed cutworms have been poisoned; otherwise not until they have ceased to feed, usually about June 20.

GRASSHOPPERS

Several kinds of grasshoppers periodically cause damage to crops and gardens in Saskatchewan. All of these overwinter in the egg stage in the soil and hatch in the spring. A number of other kinds overwinter as partially grown grasshoppers, and may be seen during warm periods of autumn, winter or spring, but these are of no economic importance.

Spring infestations are of two general types: (1) Those developing from eggs deposited along field margins, such as in sod on roadsides, pastures and dry slough margins, or in the soil of ditch banks, drift ridges and field edges; and (2) Those arising from eggs laid generally throughout stubble fields.

Idle or recently abandoned land may be as heavily infested as adjoining cropped land. Open range land, if not overgrazed, is seldom a source of serious infestation. Weedy summerfallow may occasionally be infested. Clean summerfallow is free of infestation, and crops seeded on such land need only be protected from invasion.

An annual grasshopper forecast is made each fall and information is provided on methods of control. This is done to assist farmers in planning their farm program in relation to the type and intensity of infestation. The first guide to the farmer, however, is the abundance of winged grasshoppers on his own farm in the autumn.

Where severe egg infestations are present in stubble, special attention should be given to fall tillage of stubble land. During the winter farmers should

make sure that their community is thoroughly organized for grasshopper control. This is the surest means of securing adequate protection, even though the individual farmer can do much to save his own crop.

CONTROL

Grasshopper damage can be greatly reduced or practically eliminated by proper tillage measures combined with poisoning. Tillage measures are effective in reducing egg infestations, in slowing down invasions, and in concentrating grasshoppers so that poison can be used more economically.

1. **Proper tillage is the key to successful control of stubble infestations** whether in fields to be cropped or in fields to be summerfallowed. Tillage will give excellent control of light or moderate stubble infestations and will reduce severe infestations materially providing it is done properly and before hatching begins. Fall tillage is preferable but spring tillage is often just as effective. Early fall tillage immediately after harvest may reduce egg laying and will assist in the destruction of eggs already present. The time of tillage and the machinery to be used will be determined, however, by their effect on soil drifting. **Moldboard plowing** five inches deep, followed by packing, is the surest method of grasshopper control in stubble fields in those districts where plowing is a good farm practice. **Shallow cultivation,** about two inches deep, is effective, particularly in the drier prairie region. The oneway disc is the most reliable for this purpose, but the duck-foot cultivator, single, double, or oneway disc harrow are nearly as satisfactory. The "blade" implements, while giving some measure of control, are less effective than the others.

2. **Destroy grasshoppers while preparing new summerfallow** to prevent them from moving into adjacent crops. Even light infestations of grasshoppers moving off blackened fallow into the borders of seedling crops will cause considerable damage. Crops seeded on severely infested stubble land are frequently a complete failure and the power, seed, and resources used in seeding them are wasted. Such fields should be summerfallowed to ensure that they will be free from egg infestation the next year.

The following method of preparing summerfallow should be used annually during even the lightest outbreaks: (a) The entire field should be worked before the 'hoppers hatch, but if this is not possible, at least work a black guard strip, about three rods wide, around the field. (b) In severe infestations leave a temporary weedy trap strip, about three rods wide, around the field just inside the guard. (c) While the 'hoppers are still small, work the remainder of the field towards the centre or in lands, finally leaving a weedy trap at least three rods wide (see diagram). (d) Poison the trap strips as soon as any 'hoppers gather there; repeat poisoning as necessary.

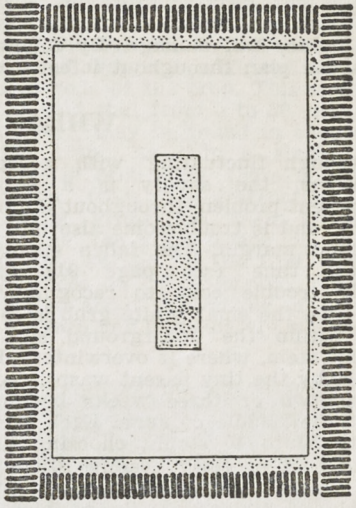


Diagram of GRASSHOPPER TRAPS in stubble field being summerfallowed. Dark bars show GUARD STRIP, early worked around edge of field. Dots indicate weedy TRAP STRIPS (left unworked until after hoppers are killed) where poisoned bait is spread. In large fields more than one strip may be left. Remainder of field is worked in the usual way. See text.

3. **Kill grasshoppers by poisoning.** Start poisoning 'hoppers as soon as they hatch and before they begin moving into crops. Grasshopper bait spread very thinly, not more than 20 lbs. of wet bait per acre, is very effective against both young and adult grasshoppers. Baiting should be continued throughout the season wherever damage continues to occur and wherever egg laying is in progress. Mechanical bait spreaders are very efficient where large areas require baiting within short periods of time. Hand spreading is just as effective where the area to be poisoned is small. Bait should be spread in the morning of days that promise to be clear and warm. It should not be spread on days that are cold or wet.

Sprays or dusts, such as chlordan or chlorinated camphene, although more expensive, may be used to kill grasshoppers. To be most effective these must be applied to vegetation on which grasshoppers are feeding. Satisfactory results have not been obtained under conditions of sparse dry vegetation. These materials should be used according to manufacturer's recommendations and precautions.

A black unseeded barrier, a few feet wide, at the edge of the crop may help to slow down invasion by newly hatched hoppers.

4. **Reduce fall damage.** By following the above plan throughout infested districts head clipping of grain at harvest time will be greatly reduced or prevented. The greater part of this damage is not due to invasion from distant areas but is usually a direct result of delayed or inadequate tillage and baiting in the the local community during the spring and summer.

Do not sow fall crops in outbreak areas without adequate preparations for grasshopper control. Very low populations of mature (winged) grasshoppers will destroy seedling crops of winter wheat or fall rye. These crops can be protected by the use of poisoned bait but attention should also be given to the time of seeding, preparation of seed bed, and type of infestation present.

WHEAT STEM SAWFLY

Although fluctuating with seasonal conditions, the sawfly is a serious permanent problem throughout the open prairie, and is troublesome also into the parkland margin. The fallen stems at harvest time (see page 91) make sawfly trouble easy to recognize. At that time the small white grub is found only within the underground stub of the cut stem, where it overwinters. Egg laying, by the tiny parent wasps, occurs during two or three weeks beginning about the middle of June. Each female infests 30 to 40 stems, choosing those in the boot or early heading stage but still growing vigorously. Although capable of flying a mile or more in search of suitable plants during hot, calm weather, they mostly drift from plant to plant once they have found an attractive crop or trap.

Damage is always worst in early-sown sawfly-susceptible wheat and spring rye. Damage occurs in three ways: first, the feeding of the grub takes nourishment from the head and causes about 10% loss in yield; second, the weakened stems often break over prematurely during storms and fail to fill; and third, the stems break off at the ground level when ripe and many of the heads are lost. The greatest loss occurs in crops which are not harvested until they are dead ripe. Losses exceeding 10 bushels per acre have often been observed in such fields.

Most of the sawflies which lay their eggs in the new crop, come from the previous year's wheat or spring rye stubble. If a susceptible wheat or spring rye is seeded early on such stubble, the result is a very heavy infestation which causes serious loss to that crop and sharply increases the hazard in the following year. Almost equally favorable to sawfly increase is the continual alternation of untrapped wheat and summerfallow in adjoining fields or strips.

CONTROL

Use Rescue wheat.—Rescue wheat should be grown throughout the brown soil zone and in parts of the dark brown zone where the sawfly has been a continuous, serious problem. (See Cereal Crops section, page 37, for recommended areas.) Field results indicate that very sharp reductions in the amount of damage can be expected even in the first year. Rescue wheat is not entirely immune, and the degree of cutting may vary somewhat from year to year and between areas.

In areas where Rescue wheat is not recommended, the control of sawfly is based on five simple principles:—

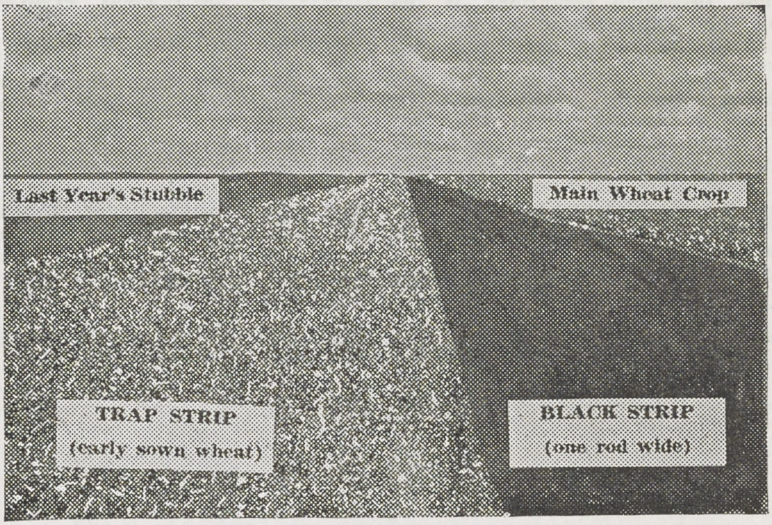
1. **Use sawfly-resistant crops to reduce the hazard.**—Flax and oats are immune. Prospect and Rex barley are highly resistant. O.A.C. 21 and Hannchen barley, Pelissier and Mindum varieties of durum wheat, and fall rye suffer some damage and may carry over a considerable number of sawflies. There is great advantage in grouping together fields or strips of resistant crops, summerfallow and very late-sown wheat, to free blocks of land from sawfly. This is particularly advisable on that part of the farm most subject to infestation. In adopting this plan, all infested stubble fields should be thoroughly trapped so as to reduce migration as much as possible. Seeding of immune crops tends to concentrate

the sawflies in the traps. In addition, many sawflies will lay their eggs in the oats and barley and there perish. As a result, adjoining wheat fields are much less likely to be heavily infested. Planning along these lines is especially important in strip cropping areas (see page 13, Soil Drifting section).

2. **Use "traps"* to help protect the new crop of wheat and also as the chief means of killing sawflies.**—Some prime essentials for effective traps are: (a) The traps must be placed between the infested stubble and the new wheat crop. If the stubble fields are large, additional traps should be seeded. (b) A trap should be at least 16 feet wide. (c) It must be very attractive during the time the eggs are being laid. Early sown wheat makes the most effective traps, provided special pains are taken in seeding them. (d) The trap should be showing before the wheat crop is seeded; the longer seeding of the wheat crop is delayed, the more effective the trap will be and consequently the lower the infestation of sawflies in the main crop. (e) The traps must be "destroyed" as soon as egg-laying is complete so that sawfly grubs cannot mature in them.

Traps **on infested stubble** are primarily for the purpose of trapping sawflies at the source and thus reducing migration. Traps **on fallow** give essential further protection of the main wheat crop from invasion. Leaving a bare strip (one rod wide) between this trap and the main wheat crop makes the trap more effective. The bare strip should be free from weeds and volunteer crop growth during the flight period.

Trapping reduces sawflies in the following way: By placing a strip of early-sown wheat between the infested stubble and the new crop, the sawflies cannot reach the main crop except by passing through the trap. The eggs laid in a good trap are sufficient to infest 5 to 10 rods of the crop. This is shown by the fact that from 5 to 30 eggs, and even more, may be found in each stem of the trap. As only a single grub survives in each stem, there is a large reduction from self-destruction. The remaining grubs are then killed by destroying the trap. Traps on stubble should be worked up the first week in July. Those on fallow should either be cultivated about the middle of July, or cut for feed and immediately worked up.



The principle of trap-stripping is illustrated in this photo-diagram. The trap strip of early-sown wheat is seeded first and seeding of the main crop is delayed until the wheat in the trap is showing through the ground. Between the trap and the main wheat crop is an unseeded strip one rod wide which must be kept black from June 10 for about three weeks.

*Spring rye also makes a good trap when seeded 10 to 15 days later than wheat traps. Oats are useless as a trap. Where brome grass grows well along ditches and fence rows it makes a useful permanent trap, since it is very attractive for egg-laying, but few sawflies mature in it. Western rye grass and couch grass are also attractive to sawfly, but must be mowed in mid-July each year to avoid a dangerous carryover of sawfly. There is very little breeding in crested wheat grass or "prairie wool."

3. **Seed in the best sequence,** that is, the sawfly traps first, then oats, barley, and flax, and the wheat crop last. This not only gives protection to the wheat crop and increases the effectiveness of the sawfly traps, but it also brings the seeding of each crop at the season when, in the severely infested area, it will normally give the best yields. Where there is an emergency infestation of sawfly, a greater delay of seeding the wheat crop is needed to help establish control.

4. **Use very shallow tillage* to further reduce sawfly numbers.**—First, in the fall as soon as possible after harvest, work a few rods at the margins of wheat stubble fields. Second, use shallow tillage as the first operation in summerfallowing wheat stubble. The object of shallow tillage is to lay the grub-infested stubs on top of the soil, where if it is hot and dry the grubs will be killed by exposure. It also brings about earlier emergence of those that survive and this also makes the traps more effective. Unless the tillage operation is shallow, it has the opposite effect. In most instances, one-waying is done too deeply. However, kills of as high as 75% can be secured, under the most favorable conditions, if the oneway or single disc is properly adjusted to the job in hand—exposing sawfly stubs.

5. **Salvage heavily infested crop by swathing or binding it in the late dough stage.**—Under favorable conditions this greatly reduces the loss. It is not a cure-all, however, because it does not kill sawflies and may not even reduce sawfly damage if weather conditions are bad at harvest time. When sawfly control is well established, heavy infestations are usually restricted to the margins of fields.

Sawfly control, when properly applied, is an integral and profitable part of the permanent farming program which in each locality and on each farm must take due account of all farm problems. Sawfly infestations vary widely from place to place. Therefore, the principles of control will of necessity be applied in different degrees of intensity. In every case, however, the action taken to control sawfly must be sufficiently complete to meet the needs of the locality. Whatever plan is used in a district, every individual farmer should observe sawfly movements and infestation. This will enable him to determine in advance the best method of harvesting and to check on the effectiveness of the control methods used. The knowledge thus gained will point the way for further improvements in the program for succeeding years.

In districts where sawfly infestations are extremely severe, the permanent control program has not proved adequate to establish control, or is too slow. Under these conditions **drastic measures** are necessary for at least a year to reduce the pest to the point where the permanent program can then maintain control. The drastic measures for that year consist of: (a) the increased use of oats, barley and flax; (b) restricting wheat acreage to that which can be sown after about May 20th; (c) using sawfly traps around all wheat stubble.

Community co-operation gives quicker and better results under all conditions. Without co-operation there can be no permanent reduction in sawfly numbers in areas of heavy infestation.

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*In districts where moldboard plowing is a good common practice, it can be used to similar effect if five inches deep, well turned and well packed. Stubble burning does not destroy sawflies.

TABLE 1.—OTHER INSECT PESTS OF FIELD CROPS

Insect	Plants Attacked	Description: Injury, Pest, Season of Attack, Area	Control (numbers in brackets refer to formulae, page 101.)
APHIDS	Grains, especially late oats.	Tiny, green sucking insects cluster about head and stem from mid-summer to fall, especially if rainfall above normal. Damage inconspicuous.	Loss rarely serious; no practical control.
SAY'S GRAIN BUG	Wheat. (Young stages on Russian thistle, mustards).	Plants appear normal but kernels shrivelled, due to flattened green stink bug sucking juice from them in dough stage. Occasionally troublesome in southern Saskatchewan.	Destroy hibernating bugs by burning weed trash along fences and road ditches in morning or evening in early spring.
WHEAT STEM MAGGOT	Wheat, rye, barley.	Infested heads empty, turn white prematurely, rest of plant remains green; stem chewed, weakened, often discolored inside sheath at top joint by tiny white maggot. Occurs chiefly in park belt.	Loss rarely serious; no practical control.
ARMY-WORM*	Oats, wheat, brome grass; occasionally other grains and grasses; rarely legumes.	Large, dark, greenish-brown worms with conspicuous stripes down side, eat leaves, drop heads and panicles; damage continues in stook; worms feed late afternoon and evening, hide under clods and stooks by day; sometimes "march" in armies. Occurs chiefly in eastern half of province.	Scatter poisoned bait (7) in afternoon or early evening just before worms become active. Stop migrating "army" with a deep furrow and poisoned bait.
WHEAT HEAD ARMY-WORM	Wheat and barley; also other grains and grasses.	Ripening kernels partly or wholly eaten by slender, striped, brown, tan or greenish worms; plant heads not cut off; worms frequently abundant in loads of straight-combined grain, but damage does not continue after grain is cut. Occurs throughout prairie area.	Reduce infestation of overwintering pupae by shallow fall tillage of heavily infested stubble. Avoid seeding wheat or barley on stubble heavily infested the previous year. If control of worms necessary, dust with 3% DDT at 30 lbs. per acre, or spray (5).
BERTHA ARMY-WORM	Flax, Argentine rape, sweet clover, alfalfa; vegetables; weeds.	Seeds, heads, flowers and leaves eaten or dropped to ground in July and August by large, conspicuous worms; color of the back varies from green to nearly solid black; armies may migrate out of destroyed fields. Occurs throughout province.	Dust infested fields with 3% DDT or arsenical (2) at rate of 20 lbs. of mixture per acre as soon as worms seen, or spray with DDT emulsion (5). On vegetables use derris (1). Reduce infestation of overwintering pupae in heavily infested fields by 3-4 inches deep fall tillage.**
FLAX BOLL-WORM	Flax.	Brown bolls appear prematurely in green crop, seeds eaten out, round hole in side of boll, but bolls not dropped to ground; inconspicuous green worms live inside boll until part grown. Occurs chiefly in western Saskatchewan.	Reduce infestation of overwintering pupae by shallow fall tillage of heavily infested fields.** No satisfactory control of the worms.
TURNIP BEETLE	Rape.	Leaves and pods eaten by red, black-striped beetles that invade fields in latter part of June from adjacent fields of rape stubble or weedy mustard fields, and which may reappear again in August.	Dust with 3% DDT at 30 lbs. per acre, or spray (5). Fall or spring cultivation of rape stubble or fields weedy with mustard.
FLEA BEETLES	Rape.	Small round holes eaten in leaves by tiny quick-jumping beetles. Early seedlings may be destroyed; in the fall seed pods may be damaged.	Dust with 3% DDT at 30 lbs per acre, or spray (5) as soon as damage noticed.
SWEET CLOVER WEEVIL	Sweet Clover.	Crescent-shaped notches chewed in leaves from early spring to late fall by small inconspicuous, dark gray snout beetle; plants may be defoliated; seedling stands often destroyed. Occurs throughout province.	Avoid seeding new stands adjacent to infested sweet clover; destroy beetles in second year stands by shallow tillage in late July, immediately after taking off the hay crop; plow defoliated field margins 6 inches deep in October; dust clover not to be used for hay or pasture that season with 3% DDT at 30 lbs. per acre or spray (5).
LYGUS BUG	Alfalfa grown for seed	One-quarter inch long greenish bugs suck juices from plant; buds wither giving "white-top" appearance; excessive drop of flowers and small seed pods; discolored and shrunken seeds found before frost occurs.	Complete burning of alfalfa stubble before any growth starts in the spring and followed by dusting with 3% DDT at a rate of at least 20 lbs. per acre, or spraying (5) in late bud stage.

*For the Beet Webworm, which is often, though incorrectly, called Armyworm, see Table 2.

**On combined fields a better job of tillage is obtained if the windrows of flax straw are bunched and removed.

For further information on these or other insect pests of field crops, write to the Dominion Entomological Laboratory, SASKATOON.

SPRAYING AND DUSTING EQUIPMENT

For field use power operated dusters or sprayers giving uniform coverage are essential to obtain control with the minimum of insecticide. Any of the power operated dusters, including the turbine sprayer-duster, or low pressure low volume sprayers used for herbicide application, are equally satisfactory for applying insecticide dusts and all sprays except suspensions. Suspension sprays, such as the wettable spray powders and arsenicals, can be used in the low volume sprayers only if these are suitably modified, because the suspended solid particles may clog screens and spray nozzles.

For general treatment of shelterbelts turbine sprayer-dusters, orchard type dusters, or high pressure, high volume orchard type sprayers are necessary. (See Spraying Farm Shelterbelts, page 102). For treating orchard trees and to some extent shelterbelt trees, bucket, barrel and tank sprayers and hand dusters recommended for treatment of gardens can be used.

For treatment of row crops and market gardens row crop dusters and sprayers are most efficient. The field and orchard equipment described above can be used but some waste of insecticide will result.

In the average garden the less expensive manufactured sprayers and dusters — syringes, atomizers (small household fly sprayers), three to five gallon tank sprayers, bucket and barrel sprayers and hand dusters (plunger and bellows type) are suitable for all kinds of foliage pests. They are essential for controlling plant lice and mites where forceful application of the insecticide is necessary to reach the undersurface of the leaves. Atomizer sprayers can only be used for sprays which do not contain solid particles in suspension. The other types of sprayers can be used with suspensions as well as soluble materials, but the container must be shaken at short intervals to keep the poison in suspension.

Where manufactured equipment is not available, improvised spraying and dusting equipment can be used to apply insecticides for controlling chewing insects on garden plants and shrubs. A brush or watering can will serve for sprinkling the spray on the foliage. A can with several small holes punched in the bottom or a small bag of coarse-mesh cloth attached to a stick is suitable for applying dusts. The cloth bag, if attached to a long thin pole, also works well for dusting small and medium-sized trees.

All spraying and dusting equipment should be cleaned thoroughly after each use. It is especially important that herbicides be cleaned out thoroughly before using the sprayer or duster to apply an insecticide. If this is not done susceptible crops may be seriously damaged.

COMMON INSECTICIDES AND THEIR USE

The insecticides recommended in the tables and formulae act either as stomach poisons, contact poisons or both. Caterpillars, beetles, etc., chew and devour the foliage. They are commonly controlled by dusting or spraying the plants with insecticides which kill by being eaten with the foliage (formula 2). These poisons will not kill certain pests such as aphids and leafhoppers which suck the juices from plants but do not eat holes in the leaves. To control these, spray or dust the insects themselves with insecticides which kill by contact (formulae 3, 4). However, "contact" insecticides are often used for the control of some chewing insects. Certain insecticides (formulae 1, 5) will kill either when eaten with the foliage or by contact.

The insecticides* listed are sold by all seed houses and most local hardware and drug stores. Two or three of them will serve nearly all needs on the farm. It is a good plan for the farmer to keep on hand, stored in a safe place, a supply of DDT, an arsenical and nicotine sulphate as these can be kept indefinitely without losing their strength. It is advisable to obtain a fresh supply of derris or pyrethrum each year since these may lose their strength. Special materials, such as corrosive sublimate, calomel, and dry lime sulphur (Table 2), are required only where certain pests are troublesome.

The best time to apply dusts is in the late evening or early morning when it is calm and the plants are damp with dew. Sprays generally can be applied throughout the day. Whether a dust or spray is used, it is important that uniform and complete coverage be obtained.

*Several powerful insecticides such as chlordan, chlorinated camphene (p. 96) and benzene hexachloride (p. 93) are becoming available. Others are likely to appear in the near future. These should be used strictly according to directions and for the purposes specified on the container.

FORMULA 1—DERRIS (Rotenone)

Use commercial derris or other rotenone preparations as directed on containers. Apply during the warmest part of the day. Dust or spray both plants and insects. Derris is a very valuable insecticide because it kills insects either by contact or as a stomach poison, but is not dangerous to humans. It can be used safely even on plant-parts soon to be eaten by humans. Store derris in a cool dry place away from direct sunlight.

FORMULA 2—ARSENICAL DUSTS AND SPRAYS

Arsenicals are the cheapest poisons for use against insects which devour the foliage, and remain effective until washed off. They will control most other leaf-eating insects, as well as those specifically mentioned in Tables 1 and 2, and are especially valuable for use against such pests on trees. However, they are entirely useless against sucking insects. **All arsenicals are deadly poison to humans and livestock.** Vegetables and fruits which have been treated with arsenicals must be thoroughly washed before they are eaten.

Dust

Arsenate of lime (or Paris Green or arsenate of lead) ..... 1 part
Flour (or hydrated lime or road dust) ..... 10 parts

Mix the poison and carrier thoroughly by shaking in a closed container, or use a commercial prepared arsenical dust. Apply if possible when the foliage is damp and cover it thoroughly with the dust.

Spray

	Small quantity	Larger quantity
Arsenate of lead or arsenate of lime	2½ level tbsp.	1½ cups
Water	1 gallon	10 gallons

Mix the poison with a little water to make a smooth paste; then stir thoroughly into remainder of water. Keep well stirred while applying. Where necessary, Paris Green may be substituted in the spray, using it at only half the strength shown, but hydrated lime equal to four times the amount of Paris Green must be added.

FORMULA 3—NICOTINE SULPHATE SPRAY

	Small quantity	Larger quantity
Nicotine sulphate, about	1½ teaspoonfuls	2½ ounces
Soap (1 inch cube equals 1 ounce)	1 ounce	8 ounces
Water	1 gallon	10 gallons

Dissolve soap in warm water, cool, and add nicotine sulphate. Mix thoroughly and use promptly. Effective only when it actually hits the insects as it kills by contact. Apply during the warmest part of the day when insects are active. Vegetables are safe to eat a day or two after treatment with nicotine sulphate, although both the spray and concentrate are very poisonous.

A combination stomach and contact spray can be made by using nicotine sulphate with arsenate of lead (Formula 2), but soap must not be used.

FORMULA 4—PYRETHRUM

Use commercial pyrethrum preparations (liquid or powder) as directed on the container. When mixed, must be used promptly. The spray or dust must hit the insects as pyrethrum kills only by contact. Apply during the warmest part of the day. Pyrethrum is not dangerous to humans. Store in tightly sealed containers in a cool dark place, and secure new supply each year.

FORMULA 5—D.D.T.

D.D.T. is a combination insecticide that can be used against both chewing and sucking insects. It will remain effective on vegetation up to two to three weeks following application, and for longer periods when applied to inside walls of buildings. D.D.T. dusts ready for application, wettable powders and emulsions will not injure most plants and animals. Oil sprays are to be used only on buildings since they will injure plants or animals. D.D.T. should not be used on fruits or the edible parts of vegetables which are to be picked soon after treatment. All precautions given by the manufacturer should be followed. Suggested sprays for gardens, shelterbelts, and orchards are:

	Small quantity	Larger quantity
25% emulsion	1 level tablespoon	½-2/3 cup
or 50% wettable powder	2 level tablespoons	3½ ounces
Water	1 gallon	10 gallons

In spraying fields with low volume power sprayers apply ¾ pound actual D.D.T. per acre or approximately 1 quart of 25% emulsion in the amount of water the sprayer delivers per acre.

FORMULA 6—CORROSIVE SUBLIMATE OR CALOMEL

Dissolve 1 ounce (60 tablets) of corrosive sublimate, *or* 1 ounce of calomel, in 10 gallons of water. Use only glass, wooden or earthenware containers, as these poisons lose their value if they contact metal. Prepare freshly for each application. **These are deadly poisons.**

FORMULA 7—POISONED BAIT

	Small quantity	Larger quantity
Bran	2 quarts	25 pounds
Paris Green	2 teaspoonfuls	¼ pound
Water, to moisten, about	2 cups	2½ gallons.

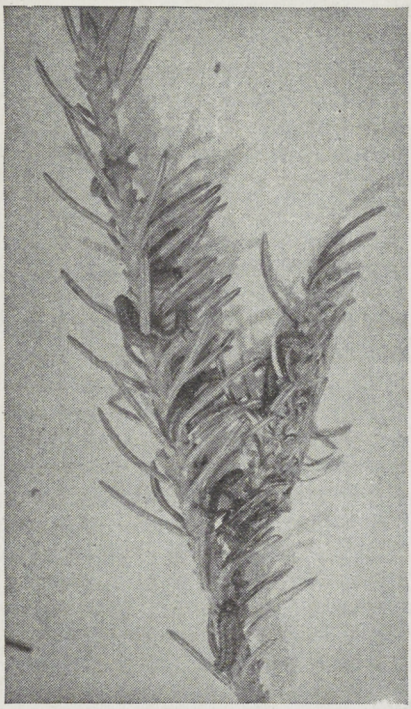
Thoroughly mix the bran and poison while dry; then stir the water into the poisoned bran until all is well dampened, but not wet enough to drip out.

Where available, sodium fluosilicate is an even better poison for cutworm baits. It is used at twice the rate of Paris Green, which it replaces in the formula.

CAUTION.—Keep all poisons and equipment where they are safe from children and livestock. Avoi inhaling poisonous dusts or fumes. Do not allow poison to get into cuts or sores. Thoroughly was fruits or vegetables before using for food.

SPRAYING FARM SHELTERBELTS

General treatment of farm shelterbelts is often necessary for the control of major tree pests, e.g., fall canker-worm, sawflies, etc. Such control should be organized on a community basis with one machine serving the needs of several farmers, as each farmer cannot supply the high pressure sprayer, blower type sprayer, or duster needed.



Yellow-headed spruce sawfly larvae defoliating spruce twig.

Where serious situations occur and community control arrangements cannot be set up a limited spray service is available through the joint efforts of the Forest Nursery Stations at Indian Head and Sutherland, and the Dominion Entomological Laboratory at Indian Head. This spray service is intended only for emergency and demonstration purposes on a limited scale, and can be provided only for organized groups of farmers. It is not available to individual farmers. A small fee is charged for this service.

For information about this shelterbelt spray service, write to the Dominion Entomological Laboratory, Indian Head, or to the Forest Nursery Station at Indian Head or Sutherland.

FURTHER INFORMATION

Information concerning insect problems treated briefly or not at all here, as well as special discussion of individual problems, may be obtained by writing to the Dominion Entomological Laboratory, University of Saskatchewan, Saskatoon, Sask., or if relating to shelterbelt or forest insects, to the Dominion Entomological Laboratory, Indian Head. Where possible, specimens of the insect and the damage should be sent with the inquiry.

TABLE 2.—CONTROL OF COMMON INSECT PESTS IN FARM GARDENS

Insect	Plants Attacked	Description: Injury, Pest and Season of Attack	Control (numbers in brackets refer to formulae, page 101)
ANTS	Do not eat plants. Feed upon nectar, etc.	Make holes, mounds, and loosen soil around roots; invade houses. Often indicate presence of aphids.	Dust the mounds or holes with 5% chlordane, 10% DDT or derris (1) two or three times at weekly intervals.
APHIDS (Plant Lice)	Currants, peas, delphinium, etc., caragana, elm, Manitoba maple, fruit trees, etc.	Leaves deformed, curled, discolored, by tiny, soft, sucking insects which cluster on the under surface of the leaves, tips of twigs, seed pods, etc. Leaves may drop. Late spring and summer.	Spray the insects on a warm day with nicotine sulphate (3) or pyrethrum (4). Apply forcefully. For spruce and balsam spray as soon as the insects are noticed. For all other plants spray before the leaves are curled, and direct it especially against underside of leaves. Repeat treatment as needed.
	Spruce, balsam.	Needles of new growth curled and stuck together with sticky secretion, by tiny, green, sucking insects. Or, clusters of black, soft insects on the bark of the twigs and branches. Late spring and early summer.	
BEET WEBWORM (incorrectly called armyworm)	Garden plants, alfalfa, rape, flax, pigweed, Russian thistle, etc. (Do not attack grains or grasses).	Gardens quickly eaten up by slim, small, active caterpillars, green, marked with fine black lines and circles Outbreaks occur in early July or in August. Armies migrate from weeds when these dry up or are eaten.	Prevent invasion of gardens by destroying all surrounding weeds early in June; or by dusting weeds with derris, or Paris Green 1 part to 5 parts cheap flour, or by using freshly cut weeds poisoned with 1 lb. Paris Green to 50 lbs. weeds in several deep furrows in front of advancing armies. If garden or susceptible field crop infested, dust with derris at 30 lbs. per acre, or where safe use arsenical (2). DDT not effective.
BLISTER BEETLES	Broadbeans, onions, caragana, potatoes, beets, honeysuckle, ash.	Blossoms and leaves devoured by large, soft, active, slender beetles, blue, bronze, black, gray, or spotted. Appear suddenly, often in large swarms, May to August.	Spray beetles with pyrethrum (4) or dust with 10% DDT. Act promptly, especially to save beans. Repeat daily as long as beetles are common. On shrubs and potatoes use Paris Green spray (2) or 10% DDT dust on foliage.
CABBAGE WORMS	Cabbage, cauliflower turnips.	Large circular holes eaten in leaves and hearts of plants by green caterpillars. Masses of soft green pellets. Throughout summer.	Dust young plants with arsenical (2), 3% DDT, or derris (1). Repeat as necessary. Use only derris or pyrethrum (4) after heads begin to form.
CURRANT CATERPILLARS	Currants, gooseberries	Leaves devoured by green, spotted caterpillars. Appear with first leaves and occur throughout summer.	Dust or spray the foliage with derris (1), arsenical (2), or DDT (5) as soon as leaves well formed; repeat as necessary. After fruit appears use only derris (1).
CURRANT MAGGOT	Currants, gooseberries	Infested fruit ripens and drops prematurely. Tiny white maggot feeds within the berry.	Control difficult. Spray bushes until they drip with 1 level tablespoon 50% DDT powder to 1 gallon of water just after petals fall (towards end of May) and again after 10 days.
CUTWORMS	All garden crops.	Stems cut off at ground level by dull-colored, fleshy caterpillars which curl up when disturbed. Feed by night, hiding in soil by day. May and June.	Scatter poisoned bait (7) on a warm evening. Best results from baiting every year before garden is up but after destroying weeds. May need to repeat. Protect cabbage plants, etc., with tin can or paper collars sunk 3 inches in soil. Where possible prevent infestation (see page 94).

TABLE 2.—Continued

FLEA BEETLES	Cabbage, turnip, rape, radish, potatoes, etc.	Small round holes eaten in leaves, and in fall seed pods damaged by tiny, quick-jumping beetles. Early seedlings may be destroyed. Present in spring until July and again from August onwards.	Dust with 3% DDT or derris (1) or spray with DDT (5) as soon as plants emerge or are transplanted. Repeat as necessary.
GRASS-HOPPERS	All garden crops.	Entire plants devoured quickly by adults, more slowly by young hoppers.	Broadcast poisoned bait when hoppers begin to feed. Repeat daily during invasions. Use bait (7, or from mixing stations).
POTATO BEETLE ("bug")	Potatoes, wild tomato, egg plant.	Foliage devoured both by round-backed striped beetles and fat reddish grubs. Throughout summer.	Dust or spray the plants with arsenicals (2) or DDT (5) as soon as beetles or grubs appear on plants. Repeat as necessary.
RASPBERRY MITE	Raspberry, etc.	Leaves turn brown and dry up. Under surface of leaves covered by very fine silken web. Pest almost too small to be seen.	Spray underside of leaves with derris (1) or dust with dry lime sulphur, 1 part to 18 parts flour as soon as first symptoms seen; repeat one week later. Where possible spray and water bushes. Watch particularly in dry years.
ROOT MAGGOTS	Cabbage, turnip, cauliflower, radish.	Roots bored into by small, white, tapering, legless maggots. Young plants killed, older plants wilt. Adults, similar to house flies, lay tiny, elongate, white eggs on or near base of stem, either at transplanting time or in mid-July.	Apply ½ cupful of corrosive sublimate or calomel solution (6) to the stems of plants as soon as eggs noticed at transplanting or in mid-July. Repeat twice at weekly intervals. Cannot control after maggot enters roots.
	Onions only.	Seedlings wilt and die. Roots and lower stems tunnelled by maggots. Infested onions rot. Throughout summer, but worst in June.	Moisten seed, roll in calomel until covered, plant immediately. Apply corrosive sublimate or calomel solution (6) over onions, soaking them and soil for 2 inches on either side of row. Apply first in late May when seedlings 1 inch high. Repeat 2 times at weekly intervals.
ROSE CURCULIO	Roses.	Buds and flowers ruined by holes bored by small red and black snout-beetles. Approximately mid-June to mid-July.	As soon as buds appear, dust or spray buds and foliage with DDT (5) or dust with arsenate of lime (2). Keep well covered with poison during beetle period. Burn damaged buds.
SUN-FLOWER BEETLE	Cultivated and wild sunflowers.	Holes eaten in leaves, flower bracts and petals by a round-backed, cream-colored beetle with black stripes, and by fat yellowish-green grubs. June to August.	Dust or spray with arsenical (2) or DDT (5).
TENT CATER-PILLAR	Rose, gooseberry, etc.	Foliage destroyed inside heavy web enclosing several branches. Dark hairy caterpillars.	See Table 3.
TURNIP BEETLE	Turnip, mustards, Argentine rape, etc.	Leaves eaten by red, black-striped bettles. Invade gardens from nearby mustard, peppergrass, etc., in latter part of June and again in August.	Destroy mustard weeds early in spring. Dust infested plants with derris (1); or where safe, use arsenical (2) or DDT (5).
WIRE-WORMS	Potatoes, lettuce, corn, onions, carrots and many others.	Seedlings wilt and die from underground boring by slender, hard bodied, shiny, yellow worms. Seeds and sprouts destroyed. Potato tubers, carrots, etc., tunnelled.	Move garden to wireworm-free area, if available. Reduce numbers in garden site by proper summerfallowing (see page 92). Soil fumigation effective but costly.

For further information on garden insects write to the Dominion Entomological Laboratory, SASKATOON

TABLE 3.—CONTROL OF COMMON INSECT PESTS IN SMALL SHELTERBELTS AND ORCHARDS

Insect	Plants Attacked	Description of Injury, Pest and Season of Attack	Control (numbers in brackets refer to formulae, page 00)
APHIDS	See Table 2.	See Table 2.	See Table 2.
BLISTER BEETLES	Caragana, ash, honeysuckle, etc.	Blossoms and leaves devoured by swarms of large, active beetles.	See Table 2. Spray the foliage with Paris Green (2).
BORERS	Ash, poplar, spruce, pine, fruit trees, birch etc.	Trees or branches weaken and die. Holes in the stems and branches. or areas of dead loose bark, caused by whitish grubs burrowing in the wood. Grubs present all year.	SPECIALIZED TREATMENT. Send sample of grubs and damage to the Dominion Entomological Laboratory, Indian Head.
BOX ELDER BUG	Manitoba maple, etc. but not harmful to trees.	An annoying house pest. Young are wingless, scarlet; adults ½ inch long, winged, flat, black with red lines. In autumn, clusters on sunny walls, etc., and invades dwellings.	On outside walls, dead trees, etc., pour hot water over clusters, or spray with kerosene; on living trees spray clusters with derris (1), pyrethrum (4), or DDT (5).
CANKER-WORM	Manitoba maple, elm, ash, fruit trees, etc.	Leaves first with small holes, later completely eaten by brownish-green looping caterpillar which spins silk thread. May and June.	As soon as damage appears spray trees with arsenical (2) or DDT (5). (Also see Spraying Farm Shelterbelts, page 102).
CECROPIA CATER-PILLAR	Manitoba maple, poplar, ash, elm, fruit trees, etc.	Leaves rapidly eaten. Young caterpillar blackish, spiny; older caterpillar large, green, with vari-colored projections. June and July. Winter as large, brown, silken cocoons on twigs and weeds.	Spray or dust trees with arsenical (2) when caterpillars first noticed. Pick and destroy caterpillars and cocoons. (Also see Spraying Farm Shelterbelts, page 102).
GRAPE LEAF-HOPPER	Virginia Creeper, grape. Also occur on many shrubs and flowers when creepers have little or no foliage	Yellow spotting and drying of the leaves with the damage developing from the ground upwards till leaves drop in July and August. Very small, yellowish, sucking insect; immature stage wingless and on under surface of leaves; mature stage winged, very active. Spring and summer.	Spray both sides of the leaves thoroughly with DDT (5) as soon as creeper is well leafed out and again during mid-July or whenever leafhoppers become abundant. Community action desirable.
TENT CATER-PILLAR **Orchard**	Rose, gooseberry, cherry, apple, etc.	Foliage destroyed inside heavy web enclosing several branches. Dark hairy caterpillars. May and June.	While tents are small, cut out and destroy them during cool weather or at night. Or, dust or spray caterpillars with derris (1) or pyrethrum (4).
Forest	Poplar, willow, etc.	Leaves devoured by hairy caterpillars that cluster on trunks and branches but do not make tents. Often in armies. Early spring to mid-June.	Spray or dust trees with arsenical (2). Destroy clusters with kerosene, oily rag, wooden paddle, etc.
SPRUCE SAWFLIES	Spruce.	Needles eaten; new growth devoured first, by green and brown caterpillar with reddish head, or olive green caterpillar with black head. June and July.	Dust trees with derris (1) or dust or spray with arsenical (2) or DDT (5). Apply treatment as soon as caterpillars are noticed. (Also see Spraying Farm Shelterbelts, page 102).
SPRUCE MITE	Spruce.	Yellowish mottling of needles with fine silk webbing around twigs between needles. Pest almost too small to be seen. Early May to end of season.	Spray trees **thoroughly** with dry lime sulphur, 1 cup to 4 gallons of water, during second week in May and again about mid-June.
PINE NEEDLE SCALE	Spruce, pine.	Yellowish mottling of needles caused by small, white, elongate, fixed objects. Present all year, but sensitive to spray only for a few days after young hatch. (Usually early in June).	Spray trees **thoroughly** with dry lime sulphur, 1 cup to 4 gallons of water during last week in May and repeat treatment second week in June.

For further information on shelterbelt and forest pests write to the Dominion Entomological Laboratory, INDIAN HEAD.

INSECT PESTS OF LIVESTOCK AND POULTRY

Injury to livestock by insects and their near allies is caused in several ways, the principal ones being as follows:

1. Irritation and loss of blood caused by blood-sucking insects, ticks and mites.

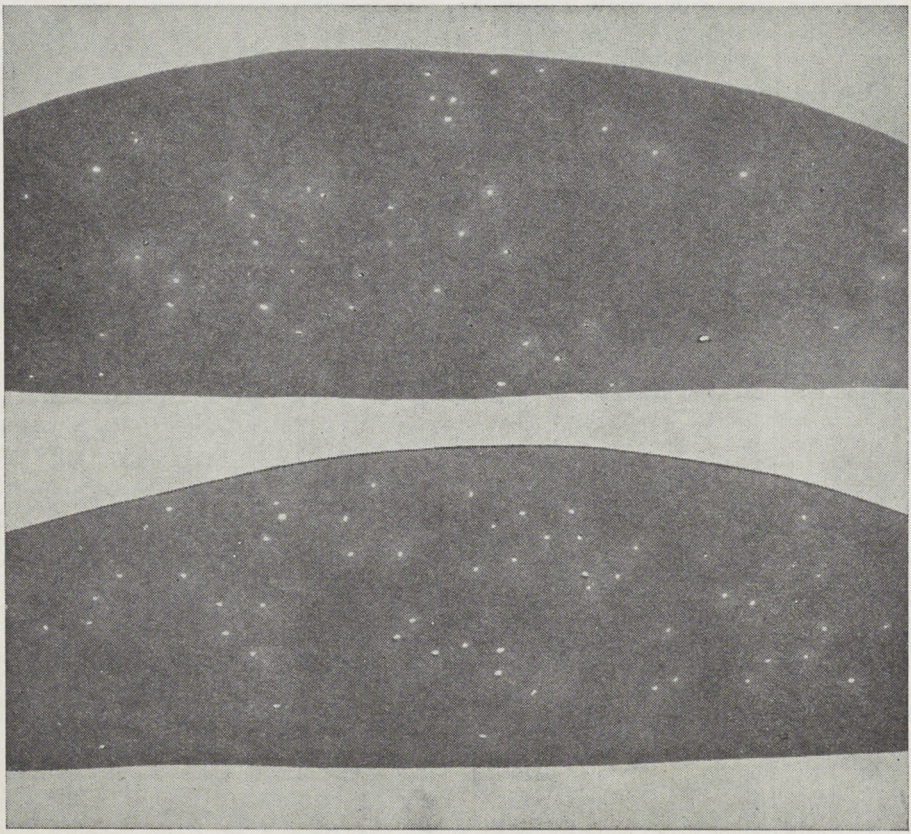
2. Poor condition and lessened milk yield in dairy cattle, resulting from infestation by the parasitic grubs of various flies which develop in the body of the animal.

3. Worry and serious interference with grazing, resulting in loss of condition, due to the attacks of the blood-sucking flies when coming for a blood meal, and the attacks of bots and warble flies when laying eggs on the animals. The efficiency of work animals is often greatly impaired when they are constantly fighting flies and they are then sometimes very difficult to handle.

4. Irritation and loss of condition through lack of sleep and rest induced by immense numbers of flies in stables, incessantly crawling over the animals and over their food.

5. Irritation, loss of condition, and serious sickness, due to the attacks of minute mites such as scab and mange mites.

6. Losses due to diseases transmitted by insects. Mosquitoes of certain species may be the principal means of transmitting encephalomyelitis of horses and man. Ticks and certain biting flies, especially deer flies, transmit tularaemia which affects sheep and some other animals. Some insects may also act as the intermediate hosts of various parasitic worms which they transmit to domestic animals.



Courtesy R. H. Painter—Livestock Insect Laboratory, Lethbridge, Alta.

Warble damage to leather. These pieces cut from the back where the most expensive part of a side of leather occurs.

INSECT PESTS OF LIVESTOCK AND POULTRY

Insect	Nature of Damage	Control
CATTLE WARBLES (Heel Flies or Gadflies)	Flies do not bite or sting, but in laying eggs on legs or lower part of body worry and frighten animals and cause gadding which reduces milk yields and weight gains. **Grubs** in animals reduce milk and meat yields and carcass grades, and cause unthriftiness, and injury to hides.	Community action highly desirable, but individual control also effective. Treat with commercial derris (warble powder). **Time:** Begin about third week of March or when holes appear in warble lumps. Treat at 30-day intervals as long as grubs are present. **Method:** (*a*) For a small herd scrub wash over back of animal with a stiff brush or rub the powder thoroughly into the holes. (*b*) for a large herd use a power sprayer at 400 lbs. pressure with a nozzle aperture of 5/64 inches delivering a 4-6 inch spray cone on the backs of the animals when held at a distance of 18-20 inches.
HORSE BOTS (and Nose Flies)	Flies do not bite or sting but terrorize animals while laying eggs on legs, lips and throat. Grubs attach to wall of stomach, intestine and anus; cause run-down condition and sometimes death.	Community action desirable but individual control also effective. Provide darkened shelters for pastured animals. Use nose muzzle or under jaw protection. Treatment by veterinarian with carbon bisulphide capsules before December 15.
HORSE FLIES (Deer Flies, Bulldogs)	Painful bites, loss of blood. May transmit disease.	Provide darkened shelters for animals. Fly nets or coverings for animals.
STABLE FLIES	Painful bites, loss of blood. May transmit disease.	Eliminate breeding places by spreading wet litter, plow under stack bottoms, make stacks moisture proof. Spray barn interior with DDT (see house flies).
HORN FLIES	Irritation and loss of blood by rather small, dark grey, biting flies clustering at base of horns and on backs of cattle. Sometimes attack sheep and horses.	Spray backs of animals with 2 quarts DDT (1 lb. 50% wettable powder to 10 gals. water) as soon as flies appear. Repeat as needed.
MOSQUITOES	Worry and loss of blood. May transmit disease. Larvae are found mainly in temporary pools in weedy roadside ditches and temporary pools in pasture depressions. Our species do **not** breed in extensive permanent sloughs nor in dugouts.	Use smudges to protect animals. Spraying with commercial fly repellents may give some relief. Community action in draining breeding places (temporary pools in grassy areas and weedy ditches) or spraying them with waste crank case oil to kill larvae soon after pools form.
BLACK FLIES	Feeding by small hump-backed greyish flies on thinly haired parts of body, particularly cows and bulls, causes loss of blood, soreness, swellings, serious illness or death within a few hours of first mass attack late in May or in June. Milk production may be reduced for several days. These black flies breed only in rocky rapids of the Saskatchewan River below Saskatoon and Prince Albert.	Farmers within about 50 miles of the Saskatchewan River from Saskatoon to Prince Albert should keep valuable bulls and milk cows in stables, or protect them by smudges during danger periods in late May and June. Spraying with commercial fly repellents or home prepared oil emulsion *, may give some protection.
HOUSE FLIES (and other flies in barns and other buildings)	The house fly is: a carrier of human diseases; transmitter of diseases of animals; intermediate host of various parasitic worms which it transmits to domestic animals. Maggots found in manure, garbage, and other decomposing matter.	Spray or brush interiors of barns, etc., with 5% DDT oil spray or a mixture of 1 lb. 50% wettable DDT in 1 gal. of water. Use 1 gal. to 1,600 sq. ft. During fly season prevent breeding by spreading manure thinly on fields.

INSECT PESTS OF LIVESTOCK AND POULTRY—Continued

Insect	Nature of Damage	Control
BLOW FLY	Eggs laid in open sores and wounds. Maggots hatching from these feed on animal tissue. Chiefly in sheep.	Burn carrion. Use repellents on open sores to kill maggots and clean wound: (*a*) commercial preparation known as Smear 62; or (*b*) creosote 1 part, turpentine 3 parts, raw linseed oil 7 parts.
SHEEP NASAL FLY	Grubs laid around nostrils; feed in nose and sinuses, causing a discharge. Sheep stop feeding and huddle together, press nose against other objects, seek shelter.	Pasture rotation. Darkened shelters. Pine tar dressing on nose to prevent grubs being laid.
SHEEP KEDS (Miscalled sheep ticks)	Brownish flattened tick-like insect about ¼ inch long. Pollutes fleece and causes greatly reduced vitality due to loss of blood and irritation. Animals damage fleece by rubbing.	Treat sheep 10-14 days after shearing in the spring with (1) commercial dip of DDT, rotenone or arsenical; or (2) spray with power sprayer under 400 lbs. pressure using 1 lb. 50% wettable DDT powder in 20 gallons water or using a .025% rotenone spray; or (3) dust with .5% rotenone powder. Store infested wool away from sheep. Pens and fields contaminated for 6 weeks after infested sheep removed.
TICKS (not to be confused with sheep keds)	Ticks attach to animals running on infested scrub-covered pastures and ranges, particularly in May and June; suck blood, causing weakness. May transmit diseases, such as Rocky Mountain spotted fever and tularaemia.	Destroy rodents on ranges. Keep animals off infested ranges. Apply a wash of 1 ounce of 50% wettable benzene hexachloride (6% gamma) in 1 gal. of water to infested parts of animal at the rate of 1 pint per animal (probably should not be used on milking cows). To remove only a few ticks, apply oil to them.
MANGE AND SCAB MITES	Attack horses, cattle, swine and sheep. Irritations cause animals to rub and scratch; scabs form in advanced stages, and there is a loss of hair or wool.	When in horses, cattle or sheep must be reported to the Dominion Health of Animals Branch. Treat swine with used crank case oil by dipping or with a brush. For horses, cattle and sheep use commercial dips containing lime-sulphur, nicotine or creosote. Two or more dips 10 days apart may be necessary. Clean up infected premises when treating animals.
LICE (of Cattle, Horses, Swine, Sheep)	Biting and sucking lice cause irritation by sucking blood and crawling on animals. Animals rubbing causes lesions and loss of hair.	Wash, dip or spray with commercial dips, or 50% wettable DDT (1 lb. in 10 gals. of water), or dust with commercial louse powders or 5 or 10% DDT. Animals should be treated twice allowing a 2-week interval for eggs to hatch.
LICE (of Poultry)	Chickens appear dopey and listless; egg production falls off.	Sodium fluoride, 5% DDT powder or other commercial louse powders well dusted into the feathers; or nicotine sulphate solution painted on roosts. Follow directions on container. Repeat in one week.
MITES (on Poultry)	Scaly legs.	Scrub, then dip legs into a mixture of equal parts of kerosene and raw linseed oil.
	Chicken mites; suck blood at night. On roosts and walls during day.	Spray used crank case oil thoroughly on interior of poultry house, roosts, nests and other fixtures. Repeat in one week.

For further information on "insect" parasites of livestock and poultry, write to the Dominion Entomological Laboratory, SASKATOON.

***Oil Emulsion Repellent:**—The mixture can be prepared as follows: Dissolve half a pound of soft soap in one gallon soft water, add to two gallons kerosene and stir thoroughly. Before spraying on the less hairy parts of the animals dilute one part of the mixture with five parts of water.

LIVESTOCK

HORSES

Although there are still over 500,000 horses in Saskatchewan, the horse as a source of farm power is now of considerably less importance than the tractor. It is generally agreed, however, that in most districts there is a place, even on the tractor farm, for a type of horse that can be used for farm work, winter driving and, on occasion, riding. It may be that horse breeding policies should be changed so that the production of this type of horse be encouraged.

Horse Breeding

The breeding of mares has, in recent years, become much less common on most farms and it is doubtful whether there are many districts in the Province where the services of a stallion could be fully utilized owing to lack of suitable mares. Artificial insemination has been used with some success to meet situations such as this and may offer some promise if a fairly widespread renewal of interest in horse breeding manifests itself.

Winter Care of Work Horses

In many parts of Saskatchewan the horses are turned out to rustle for the winter. Idle horses kept in during the winter need only a maintenance ration consisting principally of good straw or medium hay. In addition, a small allowance of grain is beneficial. Salt should be supplied. Care should be taken to avoid digestive disturbances due to the costive nature of the feed.

Preparation for Spring Work

Work horses should be hardened for spring work by putting them on better feed about a month before the field operations commence. A small quantity of grain should be fed at first, the amount being gradually increased until the horses are on full feed. Colts to be broken to harness should be hitched up frequently before spring work begins.

The feet should be trimmed at this time so that each foot rests squarely on the ground, the main points of support being the frog and the outer wall of the hoof.

Horses in low condition should be examined for lice and other parasites and given appropriate treatment. Older animals not in a thriving condition should have their teeth examined to ensure that the grinding surface of the molars is normal; uneven wear may necessitate treatment. To avoid sore shoulders, which are most apt to occur soon after the spring work commences, collars should be correctly fitted. Cleaning the face of the collar daily and bathing the shoulder with salt solution aid materially in keeping the horse's shoulders in good condition.

Care During the Working Season

The daily ration for a work horse on full feed can be computed as follows:

Roughage—1 to 1¼ pounds for every 100 pounds live weight.

Grain—1 pound for every 100 pounds live weight.

Working horses should be fed three times daily; the largest feed of grain should be given at noon and the greatest part of the roughage at night. Oats is the ideal grain to feed, but may be replaced in part by any of the other cereal grains if prices are such as to warrant this practice. If wheat is fed along with oats it may form up to half by weight of the total grain ration; if oat hulls or ground roughage are available, up to two-thirds of wheat by weight could be fed with these. Rolling or coarse grinding is advisable in the case of wheat fed to horses. It is important that any replacement of oats by wheat be according to weight rather than volume. Tame hay, prairie hay, oat sheaves and legume hay are suitable roughages. Salt should be made accessible to the horses at all times. Turning the horses to pasture at night and over Sunday aids in keeping them healthy and free from digestive troubles. When on pasture, fly shelters should be available: e.g., a shady bluff or darkened shed. While horses are working, protection against bot fly attack should be provided by using noseguards and strips of canvas or sacking stretched from throat strap to bit rings.

For further information see sections on Animal Diseases, page 140, and Insect Pests of Livestock and Poultry, page 107.

SWINE

A permanent program of pig production should be related carefully to dependability and adequacy of feed and water supplies. Where crop failures or grain shortages occur, care should be taken not to embark upon too large a program.

The Farm Meat Supply

The products of the bacon hog are more suitable for home curing and storing than those of most other meat animals. At least one litter of pigs might profitably be raised annually to provide a supply of meat for the home. February and March are the best months in which to slaughter and cure the meat. Meats cured and smoked at this time retain their attractive freshness and taste throughout the spring months, though pork products may be cured and smoked safely at any time of the year providing the proper precautions are taken. A bulletin on curing meats can be secured from the Extension Department, University of Saskatchewan, Saskatoon.

Breeding Stock

Only boars of pure breeding and good bacon type should be used. The Yorkshire breed is best suited for present market requirements and is in general favor on Canadian farms. The testing of breeding stock for size and soundness of litter, rate of growth, and carcass quality is done by the Federal Department of Agriculture, and is known as "Advanced Registry." The test station in Saskatchewan is located at the University of Saskatchewan, Saskatoon. The offspring from qualified animals represents the best stock for the production of bacon pigs. More attention should be given than in the past to length and depth of sides, break of rib and development of ham and less to such showring points as fashionable heads.

Gilts selected for breeding should represent a prolific, quick growing, high grading strain and have at least 12 normal teats. Neither sows nor boars from litters in which hermaphrodite, cryptorchid (ridgling) or ruptured pigs have occurred, should be kept for breeding.

Housing Problems

Much of the success of hog raising depends on well planned housing. Expensive buildings are not essential. Straw shelters, properly constructed and kept well bedded, are ideal for the winter housing of breeding stock. Fresh air, sunlight and exercise are important factors in the production of strong vigorous litters and these may be provided by feeding the breeding stock some distance from the sleeping quarters.

With the increased demand for bacon, more sows should be farrowed in the fall and winter months. Such a practice calls for the best care and special attention to housing and the use of the pig brooder. Plans for piggeries and brooder houses can be obtained through the Extension Department, University of Saskatchewan, or the Experimental Farms.

Breeding

The gestation period in pigs is about 114 days. In years past, the majority of litters were farrowed in the months of April, May and June. Where suitable accommodation is available, the farrowing season should be extended and, under favorable conditions, early spring pigs as well as fall pigs can be produced profitably.

The Brood Sow

The strongest litters may be expected from sows that have been maintained in medium flesh. A grain mixture composed of equal parts oats and barley or oats and wheat, is quite satisfactory for sows provided the quantity fed is consistent with vigor without overfatness, and the proper protein, mineral and vitamin supplements are provided. The feeding program during pregnancy is extremely important as much can be done to fortify the sow for parturition and lactation, with stronger pigs and more milk the reward.

A pound of skim milk or buttermilk per pound of grain or 4% to 5% of a good mixed protein concentrate is recommended to raise the protein in the ration to optimum for pregnancy. Calcium is needed and when a good level is not provided through other feeds, it should be supplied as 1% of ground limestone in the grain. To augment the vitamin supply, some alfalfa hay of good quality is recommended as a supplement and it may be placed in racks or on the ground for the sows to take as they choose. Without the alfalfa hay, an allowance of a tablespoonful daily of medium-test fish liver oil is recommended. For the last two or three months of pregnancy each sow should be given a tablespoonful every three days, of a solution consisting of an ounce of potassium iodide in a gallon of water. Regu-

lar exercise is a matter of extreme importance for brood sows.

Farrowing

Of the various periods in the young pig's life, farrowing time and the ensuing few weeks are particularly important to its welfare. It is estimated that 30% mortality in pigs occurs during the first week after birth. Special attention at this time is important.

The farrowing pen should be clean and equipped with a guard rail to prevent the crushing of the young pigs by the sow. Where the sow is heavy and clumsy it is usually advisable to use short straw for bedding.

Light, laxative and sloppy rations are best for the brood sow at farrowing time. Several days should elapse after farrowing before she is brought to full feed, but generous feeding is important thereafter if she is to nurse a big litter. For milking sows a grain ration composed of two parts of ground wheat and one part of ground oats, or two parts of ground barley and one part of ground oats, would be appropriate with skim milk, or a dependable mixed protein-mineral concentrate.

Access to sunshine and clean earth is conducive to health in the young pigs. The male pigs not intended for breeding should be castrated before weaning. The provision of some special feed for the young pigs as soon as they are old enough to eat will reduce the setback at weaning time. This should be fed several times per day for the first week or more in a separate trough away from the sow. A suitable ration consists of sifted oat chop and skim milk, or shorts and skim milk. Pigs are usually weaned at six to eight weeks of age, the earlier weaning being necessary where sows are to be bred for two litters per year.

Growing and Finishing for Market

The balancing of rations for growing pigs is not a difficult problem where buttermilk or skim milk is available in conjunction with the common cereal grains. Where neither of these dairy by-products is available, a percentage of tankage or reliable protein-mineral concentrate having a protein content of approximately 40% will give the needed balance. The best concentrates, commercial or home-prepared, include tankage, fish meal, linseed oil meal, alfalfa meal, salt and ground limestone; there should be at least 30% of material of animal origin, i.e., tankage and fish meal, in the mix. Wheat and barley fed either singly or in combination, or wheat, barley and oats fed in combination and supplemented with one of the above protein and mineral-rich feeds, will give good growth and economical gains. Wheat is low in fibre and has been shown to be particularly suitable as a basis for pig rations, but it is best when mixed with other grains. Its use may call for special care to avoid overfeeding in certain cases, pregnant sows for example.

Young pigs just weaned require feeds of high protein and low fibre content and accordingly about two pounds of skim milk or buttermilk should be used for every pound of grain fed. In the absence of milk the ration should contain at least 8% to 10% of tankage or mixed concentrate. As the pigs approach maturity a lower level of protein-rich feed will prove more economical. The quantity of milk per pound of grain may be reduced to one pound for pigs close to market weight. Under the same circumstances the mixed concentrate should be reduced to 3% or 4% of the grain. Green forage, carried to the growing pigs or provided as pasture, will reduce the amount of grain required and make for cheaper gains.

Market reports show that too high a percentage of farm pigs are marketed in the unfinished state, and that producers lose heavily by marketing pigs outside the proper weights. Pigs marketed at between 200 and 210 pounds will yield carcasses within the Grade A carcass range of 140 to 170 pounds. A scale for the purpose of weighing market pigs can be secured through Production Services, Dominion Department of Agriculture, Post Office Building, Regina, at a small cost.

The Self-Feeder

The self-feeder saves labor and may be used with success in feeding market pigs. Experimental Farm records show an increase of 19% in daily gains when compared with hand feeding, but this is partly offset by an increase in feed consumption per unit of gain amounting to 8%. For plans write to the University of Saskatchewan or a Dominion Experimental Farm, or Department of Agriculture.

The use of self-watering devices will save labor; such devices are on the market, but a home-made type consisting of a ¾ inch barrel tap with float attached to the tap lever can be constructed.

Management

Cleanliness in housing conditions is very essential and should be the keynote

of all swine raising operations. It is especially important that young pigs be protected from pens or yards which may be contaminated by disease or the eggs of parasites. Pigs allowed to run over the same ground year after year may suffer heavy losses from parasites and disease unless plowing is done annually.

The main internal parasite affecting swine is the common roundworm or ascarid. If a young pig in the first two or three months is weakened by any factor, such as poor feeding, anemia, vitamin A deficiency or excessive cold, or was born a weakling or runt, it may be highly susceptible to roundworm infection. On the other hand, well fed, thrifty pigs, provided they are kept in clean quarters, may show no ill effects from the few worms they harbor and worm treatments are unnecessary.

Heavy infestations of roundworms result in coughing and in some cases severe pneumonia. This is followed by a heavy and harmful infestation of roundworms in the intestine. It is not possible to cure young pigs at the stage when coughing or pneumonia is present. Pigs from 70 to 90 days of age should, if infected, be treated for removal of the worms.

A treatment for the removal of roundworms which is easy to administer consists in the use of phenothiazine. This drug is mixed with the feed at the following rates:

Pigs from—	
25 to 50 lbs.	9 grams (⅓ oz.)
50 to 100 lbs.	12 grams
100 to 200 lbs.	20 grams
Over 200 lbs.	30 grams

Treatment of sows, particularly those approaching farrowing time, is both unnecessary and dangerous. Pigs treated with phenothiazine should be kept out of direct sunlight for 3 to 4 days to prevent severe skin injury.

Many losses occur annually among litters that have to be kept indoors owing to cold weather in the winter or early spring months. Young pigs become anemic, lose weight and, in many cases, die. Anemia is caused by deficiencies of iron and copper. In nature, the pigs secure these minerals from the soil. By supplying the young pigs with sods or top-soil in the pens, turning them out with the sow each day, or by moving them into colony houses by the time they are two to three weeks of age, the condition can be prevented. To increase preventive value, dirt sods placed in pens for early pigs may be treated with a solution of iron sulphate; the recommendation is that about two or three tablespoonfuls of a solution made by dissolving six ounces of iron sulphate in a gallon of water, be placed daily on the sods to each pen.

The other minerals which may be deficient in common rations are common salt, lime and iodine. All pigs should be given salt at the rate of one-half to one pound in 100 pounds of grain. Growing pigs and pregnant and nursing sows should be given a similar allowance of ground limestone, especially if milk or tankage is not fed at an optimum level.

The producer should insist upon receiving a rail grade settlement for every hog sold. The Government system of rail grading provides that an official

RETURNS FROM WHEAT OR BARLEY FED WITH CORRECT SUPPLEMENTS TO PIGS, FEED FOR SOWS AND BOAR AND DEATH LOSS INCLUDED

Price Received Net for Pigs Marketed (Carcass Basis)	Feeder's Return Per Bushel of Barley		Feeder's Return Per Bushel of Wheat	
	Basis of Feed Costs Only	Labor and Overhead Included	Basis of Feed Costs Only	Labor and Overhead Included
15 cents per pound	1.02	.80	1.28	1.00
16 cents per pound	1.09	.85	1.36	1.06
17 cents per pound	1.16	.90	1.45	1.13
18 cents per pound	1.23	.96	1.53	1.20
19 cents per pound	1.30	1.01	1.62	1.26
20 cents per pound	1.36	1.06	1.70	1.32
21 cents per pound	1.43	1.12	1.79	1.39
22 cents per pound	1.50	1.17	1.87	1.46
23 cents per pound	1.57	1.22	1.96	1.53
24 cents per pound	1.63	1.28	2.04	1.59
25 cents per pound	1.70	1.33	2.13	1.66
26 cents per pound	1.77	1.38	2.21	1.73
27 cents per pound	1.84	1.44	2.29	1.80
28 cents per pound	1.91	1.49	2.38	1.87
29 cents per pound	1.97	1.54	2.47	1.93
30 cents per pound	2.04	1.60	2.55	2.00

statement be supplied to the drover or shipper for forwarding to the producer.

Note

This table is based on a study which indicated that without including labor 705 pounds of wheat or barley are required to produce 100 pounds of dressed carcass and that if labor costs are included the corresponding figure is 904 pounds.

For further information see sections on Animal Diseases, page 147, and Insect Pests of Livestock and Poultry, page 106. For information on advanced registry of swine contact Livestock Production Service, 416 Post Office Building, Regina.

SHEEP

Sheep are kept on less than 5% of Saskatchewan farms and except in the range areas of the southwest are usually found in small flocks. On farms, sheep possess considerable value as weed destroyers, and for this purpose can be pastured on summerfallow and stubble land. Where cheap or rough pasture is available, sheep raising fits into the farm program very satisfactorily, an important advantage being the double source of income, viz., wool and lambs.

Sources of Breeding Stock

The range industry produces each year more ewe lambs than can be used as replacements in range bands. This surplus, along with older ewes, forms very suitable material for foundation stock, and the farmer who intends including sheep raising in his farm program, can make an inexpensive start by purchasing a number of these fine-wool ewes. They are hardy, flock well, yield a heavy fleece of high quality wool, and, although not of the best mutton type, will produce lambs suitable for market requirements. Yearling ewes are probably the best to buy as they have all their breeding lives ahead of them; in some circumstances, however, it may be advisable to buy the older, cheaper ewes provided they are sound in mouth and udder.

To ensure a uniform lamb crop, the ewes should be uniform in conformation, size and fleece. The ram should be purebred and of medium wool type, e.g., one of the Down breeds. This type of ram, although lacking the hardiness and fleece quality of the finewool, is of better mutton conformation and will sire lambs of superior quality. The best of the ewe lambs are kept for breeding. The same breed of ram should be used each year, although the individuals will have to be changed every two years to avoid inbreeding. By grading up in this way, in a few generations a flock of very uniform type and appearance can be developed. An alternative plan is to use the range ewes as long as possible, buying young ewes of finewool type for replacement and selling the entire lamb crop each year; rams used should be of mutton type. This method has the following advantages: (a) The same rams can be used as long as they are breeding satisfactorily. (b) The ewes are hardy, are fair mothers and yield a heavy fleece of high quality. (c) The lambs, being a first cross between two breeds exhibit hybrid vigor, i.e., they are usually strong and vigorous at birth and make rapid and economical gains.

Management During Breeding and Lambing

When adequate shelter is not available, lambing should take place at a time when climatic conditions are not too severe, e.g., from mid-April onwards. As the gestation period is approximately 145 days, this means that breeding should not start before the middle of November. It is customary on the farm to "flush" the breeding band, i.e., the ewes are given a fairly generous ration for about one month prior to and during the breeding season to induce greater prolificacy. The ram during this period should be well fed to prepare him for the breeding season; some concentrates should be fed but considerable caution should be exercised in feeding such grains as barley. A mature ram is considered capable of breeding 50 to 60 ewes in a season, a ram lamb 10 to 20. During the winter the band should have sufficient exercise to ensure health, but undue exertion such as is caused by plunging through deep snow, may cause abortions.

The lambing period usually lasts from 5 to 6 weeks; it is exceedingly important that all lambs be docked and all males not to be used for breeding, castrated. These operations should be performed when the lambs are from 10 days to 3 weeks of age. If this is not done, the lambs will be heavily discounted when marketed.

Shearing

Although the wool returns less revenue than the mutton, it should not be regarded as unimportant, but strict at-

tention should be paid to maintaining the fleece quality of the breeding band. Shearing should be done after lambing is completed, when the "rise" is sufficiently high; this will probably mean some time in the first two weeks of June, although yearling ewes and mature rams may be shorn earlier. If milking ewes are shorn early, close shearing is to be avoided.

Wool should be marketed in as good condition as possible by careful attention to such points as:

(a) Cleanliness of shearing floor.

(b) Removal of tags, leg and face clippings, and burry or chaffy bellies, and packing these separately.

(c) Avoidance of second cuts in shearing.

(d) Keeping the wool free from dirt and vegetable material.

(e) Tying the fleeces with paper twine and packing in proper wool sacks.

Dipping

All sheep, including lambs, should be dipped at least once a year to destroy such external parasites as keds and lice. The best time for single dipping is 2 to 3 weeks after shearing when there is sufficient growth of new wool to hold the dip but not enough to cause undue waste. A suitable dip vat can be constructed of 2″x8″ planks. The following dimensions are suitable for the average size of farm flock: length at top 7′, length at bottom 3′ 6″, width at top 1′ 8″, width at bottom 10″, depth 5′. The capacity of this tank would be approximately 185 gallons, if filled to within 6″ of the top. The back wall should be vertical and the sides sloped equally; this gives an incline to the remaining wall which should have cleats nailed across it at intervals to allow the sheep to climb out after immersion, to the draining platform. The latter should be divided so that one-half may be filled at a time, and should be sloped so that excess dip will drain back into the vat. Three-quarters to one gallon of dip solution will be necessary per head. Spraying with dip solution mixed according to instructions on the container has given good results and proven less costly in small flocks, so far as equipment is concerned; almost any type of sprayer may be used. The sheep to be sprayed should be packed as tightly as possible into a pen and the nozzle or nozzles held above the backs of the animals. Pressures of 350 to 400 lbs. have been found satisfactory.

Stomach Worms

The most common internal parasite affecting range and farm flocks is the twisted wireworm or common stomach worm. It can be largely prevented by dosing all adult sheep with 2 tablets (20 grams) of phenothiazine before the sheep go to pasture, avoiding the period of late pregnancy. Dosage should be according to instructions on the container.

Phenothiazine-salt licks will not cure worm infestations but will help to prevent contamination of the range. Because of its labor saving features a phenothiazine-salt mixture (1 part of phenothiazine : 9 parts of salt) is recommended.

Summer Management

The band should graze on pasture all summer, and weaning may take place from August onward. The ewes at this time should be "dried off" by reducing the ration or putting them on poor pasture for a time. Culling of the ewe flock should take place between weaning and flushing. All ewes with broken mouths or bad udders or which for any other reason are unsatisfactory, should be cut out for disposal.

Feeding Pregnant Ewes

It is best to winter ewes on roughage alone unless they begin to lose flesh. A little grain may be supplied for one month prior to the start of lambing, and after lambing up to 1½ pounds per head may be fed until pasture is available. Suitable feeds are oat sheaves, prairie or tame hay, legume hay, oats and bran. To prevent the occurrence of goitred lambs, potassium iodide may be fed by dissolving one ounce in a cup of water and sprinkling the solution over 50 pounds of coarse salt which may then be offered to the ewes, free choice, in wooden troughs for the final three months of pregnancy. Pregnancy disease, a condition affecting ewes close to lambing, particularly if they are carrying twins or triplets, may be prevented, to some extent at least, by forcing the ewes to take some exercise every day and by feeding alfalfa hay. (See section on Animal Diseases, page 149.)

Feeding Market Lambs

Market lambs should be finished at 80 to 100 pounds live weight. They should be brought to a full grain ration gradually, ¼ pound per head being fed daily at the start, and this being increased as speedily as possible without causing digestive disturbances. The maximum daily amount at the end of the feeding

period should not exceed 2 pounds per head. Oats is a safe grain on which to start the lambs but the heavier grains can be included as the feeding period progresses. Grinding grain for sheep is usually unnecessary. The balance of the ration should be made up of high quality roughage such as oat sheaves, legume hay and good prairie or tame hay; oat sheaves are most suitable when fed along with some grain other than oats.

Equipment

In order to take full advantage of sheep as weed destroyers, an efficient system of fencing is necessary. A woven wire fence is most suitable for this purpose. Erection of sheep-proof fence is costly and constitutes probably the most serious obstacle to the keeping of sheep on Saskatchewan farms.

Shelter need not be elaborate; the band should have access in winter to a dry shed giving protection from cold winds. Moisture and draughts are more harmful to sheep than low temperatures. A pole shed with a straw roof, open to the south and closed on the other three sides makes a cheap and efficient shelter.

Sheep breeders should be familiar with the "Sheep Protection and Dog Licensing Act," a copy of which may be secured from the Department of Agriculture, Regina.

For further information see sections on Animal Diseases, page 149, and Insect Pests of Livestock and Poultry, page 108.

BEEF CATTLE

Some cattle are required on most Saskatchewan farms to supply household needs. In the utilization of pasture, roughages, and coarse grains, beef cattle will frequently prove to be the most efficient form of livestock to supplement the major source of farm revenues. Beef cattle will find a place of new and greater importance in districts served by community pastures.

PRODUCTION

Ranching

A part of southwestern Saskatchewan is ranching country, and capable of supplying large numbers of feeder cattle for finishing on the farms of the Province. The large areas of pasture land held under grazing leases are suitable for production of range cattle.

Farm Finishing of Range Cattle

Many of the unfinished range cattle might, to the profit of all concerned, be finished in feed lots on farms where land values are high and the scarcity of grazing land precludes the breeding or growing of such cattle.

Breeding and Finishing on Farms

In the park districts of eastern and north-central Saskatchewan, where there is usually adequate water supply, considerable grazing land, and reasonable assurance of feed, the policy of breeding, raising, and finishing by farmers is good farm practice.

Breeding

Cattle of beef breeding command a substantially better price than animals showing evidences of dairy breeding. The beef bred animals finish earlier and yield a higher percentage of dressed carcass, which is of superior quality due to thickness of flesh, evenness of covering and an abundance of marbling or inter-muscular distribution of fat.

The breeding of strictly dairy herds by men whose farming program includes dairying as a major activity is no doubt sound, but the indiscriminate use of bulls of dairy breeds in communities where beef cattle are being produced is a decidedly harmful practice.

Type of Beef Animals in Demand on the Market

While prior to the war the Canadian market favored lightweight and handyweight cattle, there seems now to be little difference in the demand as between light, handy-weight and heavy cattle. The change arose due to the strong demand in both export and domestic markets for pounds of meat rather than for carcasses of any particular weight.

Source of Feeder Cattle

Whenever possible, farm raised cattle should be finished on the farm. Feeders can be purchased locally in farming districts, on the stockyards, at feeder sales, or directly from the ranching country. The source of the cattle, however, matters less than the type, quality and price. Ranch cattle of good quality make excellent feeders. They are hardy, feed well and will finish more uniformly than most groups of farm raised cattle.

Selection of Feeder Cattle

In the selection of feeder cattle, color is only an indication of breeding, and care should be exercised to secure only

uniform, straight topped, low set cattle. Yearling and two-year-old feeder cattle require less careful and expert attention than calves in finishing for market, but the calves will make a unit of gain at a lower feed cost. Feeding and management of the young calf from birth will affect the amount of profit that will be made on the finished animal. A stunted calf, regardless of how well it is bred, will make a poor feeder. Heifers fatten more rapidly than steers, but it is important that they be placed in the feed lot at a price consistent with the probable discrimination at marketing time. The heaviest discrimination is on older heifers; females of the fed calf kind will sell practically on a par with steers of the same age and quality.

The Need for Proper Feeding

The marketing of a large proportion of our beef cattle in a comparatively unfinished condition represents a great economic waste. There appears to be a twofold advantage in fattening suitable beef animals to a greater degree than is usually done; it would dispose of surplus grains and provide a superior product. As a general rule it is most profitable to market cattle as soon as they have reached the proper state of finish. In addition to meeting domestic requirements, cattle of the proper type and finish are entirely suitable for export.

Feeding for Market

Whole oats is a favored grain for use when feeder cattle are first placed in the feed lot. Calves might be started on one pound of grain per head daily, and yearling and two-year-old cattle on two pounds per head daily. A percentage of heavier ground grain such as barley or wheat may be included in the course of a few days and the proportion increased as the amount of total grain feed is increased. The per day allowance of grain should be increased gradually. Ten pounds of grain per day may be regarded as a practical maximum for fattening calves, and from 12 to 15 pounds for the older feeders.

A small allowance of linseed oil meal, about ½ to 1 pound per day, might be included in the grain ration during the last month or two of the feeding period. This product is laxative, healthful and conducive to quality in hair, hide and fleshing.

Oat sheaves, prairie hay, domestic grass hay and legume hay are suitable for the roughage part of the fattening ration. Legume hay is most valuable when fed in small proportion in conjunction with other roughages. Some straw along with better roughage could be fed to the more mature feeders of the two-year-old order.

The use of self-feeders in fattening will result in faster gains and more certain finish, but the best measure of economy can be secured from careful hand feeding. Fattening calves require about 200 days of feeding, and will consume about 1600 to 1800 pounds of grain and about 2400 pounds of dry roughage per head.

Yearlings on feed should finish in 150 days or less and during that period will consume approximately 1800 to 2200 pounds of grain and the same amount of dry roughage per head. Salt and water should be always available for fattening cattle.

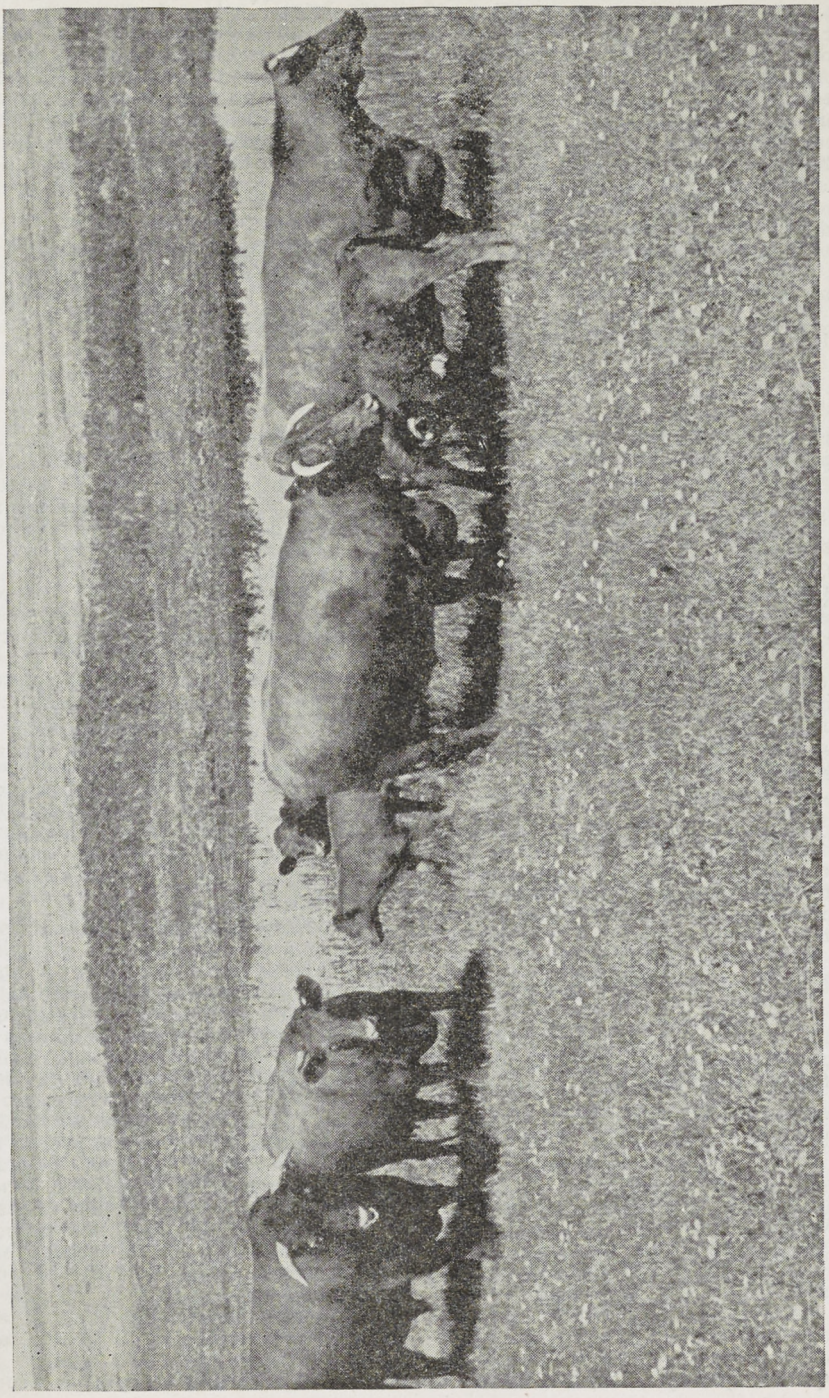
Mineral Supplements

All cattle require salt regularly. Breeding beef cattle are likely to require supplemental phosphorus more than calcium. In sections of Western Canada, depraved appetites and bone chewing have been observed from time to time, and indicate a phosphorus deficiency. When such a deficiency is suspected, a quantity of edible bone meal or monocalcium phosphate should be placed where the cattle may have access to it and eat it at will. The subject of mineral supplements is covered more fully in the bulletin entitled "The Mineral Needs of Farm Animals," which may be secured from the Extension Department, University of Saskatchewan.

Dehorning

Spring and fall are the most appropriate seasons for dehorning older cattle. The fly season and extremes of temperatures should be avoided. Caustic potash, however, can be used to stop horn growth on calves at any season.

Caustic potash is effective on young calves up to two weeks of age. The product, which comes in stick or paste form, can be purchased at almost any drug store. Vaseline should be applied around the edge of the horn button to prevent drops of liquid running down and burning the skin. If the stick is used, the upper part should be wrapped to prevent burning the fingers of the operator, the calf's head held steady, the end of the caustic stick moistened and each horn button rubbed a number of times, or until quite red. Each rubbing will take only a few seconds. If the paste is used a little should be applied to each horn button by means of a knife blade or piece of wood.



Adequate pasture and water—essentials in successful cattle raising.

Where older cattle are to be dehorned, mechanical removal is necessary. Gougers or tube dehorners are satisfactory for young calves but for cattle of one year or more a saw or dehorning clippers are necessary. The clippers permit faster work than the saw and are usually favored. For aged animals with very hard horns, the saw is a good choice as it does not splinter the bone. In any case, care should be taken to remove the horn as close to the skull as possible, so that unsightly stubs do not remain. It is common practice to attempt to remove a fringe of hair with the horn. Where there is any danger from flies, pine tar or some coal tar product should be applied to the wound and cavity.

Where cattle which had been eating sweet clover in the form of hay or silage for a period have been dehorned, excessive bleeding has sometimes occurred. If cattle being fed sweet clover are to be dehorned, this feed should be removed from the ration for a period of two to three weeks prior to the operation.

Warble Flies

In view of the extensive damage done to hides and carcasses by the grubs of the Warble Fly, attention is directed to the section on control of this pest on pages 107 and 146.

DAIRY CATTLE

Dairying in some form is found in all farming districts in Saskatchewan. The highest degree of specialization is found in the immediate vicinity of cities and towns where there is a good market for fluid milk. There is the greatest justification for high class cattle of the dairy breeds in such areas.

Most of the cream used for creamery and dairy butter is produced on farms where dairying is a sideline rather than a major enterprise. The milking of cows on such farms is sound in principle and will, in addition to providing some cash income, go a long way toward furnishing the farm family table.

Markets

The domestic market is of major importance to the producers of dairy products. Cheese alone of all dairy products has been continuously an important factor in the export trade. Canada has at times been on an export trade basis with regard to butter and, at others, she has had to import.

Type

Cattle of dairy type and breeding are recommended wherever dairying is an important farm enterprise.

Maintaining the Dairy Herd

The dairy herd can be maintained either by the periodic purchase of cows or by the raising of heifer calves. Cows of the best type are usually difficult to buy. Where a good sire is in use, the practice of raising and retaining sufficient heifers from the best cows to maintain the herd is recommended. When heifer calves are raised to replace the cow herd too much emphasis cannot be placed upon the importance of the type and quality of the sire used.

Pail Fed Calves

The first milk or colostrum, being high in protein and mineral matter, and rich in vitamin A, is necessary for the health and thriftiness of newborn calves. Whole milk, where it can be spared, should be fed for the first two or three weeks of the calf's life and then the change to skim milk made gradually over a period of one to two weeks. The first feeds of milk should be small. From 7 to 9 pounds a day, divided into 3 feeds, would be a suitable allowance for the first few days. A daily ration of milk equal to 10% of the calf's weight, is a fairly reliable rule for use in feeding young calves up to 4 to 6 weeks of age. Studies show that the stomach capacity of newborn calves is very limited and that large amounts of milk are among the most common causes of scours.

Commercial calf meals or skim milk supplements are available and give good results except that the cost is high. Several home-made calf meals are satisfactory. Equal parts by weight of ground flax, corn meal and wheat middlings or shorts have given very good results. Flax seed jelly is an excellent fat substitute for pail fed calves. The jelly is made by adding 2 pounds of whole flax seed to 1 gallon of water and boiling for 1 hour. One cup of the jelly is added to each 10 pounds of skim milk. Whole oats may be fed when the calf displays an appetite for such feed and later, a mixture of coarsely ground cereal grains may be given. Small amounts of good quality roughage should be offered at an early age. Reasonable exercise and sunshine are conducive to health, and calves should be protected against extreme heat, flies and mosquitoes. Scours

in young calves are generally evidence of digestive troubles. Overfeeding is probably the most common cause but sour milk and dirty feed pails may also be contributory causes. When scouring occurs, the amount of milk fed should be reduced to half or less and the volume made up with water.

Home-Grown Feeds

Dairy cattle require generous feeding. Particularly with high-producing cows, rations balanced with high levels of protein and mineral-rich feed are necessary. Balancing rations by the extensive use of such mill feeds as bran and linseed oil meal entails heavy expenditure which the price of dairy products will not always justify, and it is worthy of special note that practically all the components of a good dairy ration can be grown on the farm. The growing of such valuable feeds as sweet clover and alfalfa, known to be rich in protein and minerals will reduce the need for purchased feeds. Legume hay will improve any winter ration for dairy cows and, when it is included, the common coarse grains of the farm can be used to better advantage. Prairie hay, oat sheaves and other cereal hay also furnish satisfactory roughage.

Management of Dairy Cows

Under conditions which prevail most commonly, dairy heifers will be bred for the first time at about 21 months, to calve at the age of 2½ years. The dairy cow needs a dry period of at least six weeks to restore her body reserves for the next lactation. This is particularly important in connection with the bone building minerals. Just prior to calving, her feed should be slightly laxative, and some bran in her ration will accomplish this.

The cow should be placed in a clean, comfortable pen, with plenty of dry bedding, at least a few days before her calving date. If she appears constipated, a bran mash may be given. At the time of calving, an attendant should be near to give assistance, if required. Some times a slimy membrane will be found clinging to the nostrils of the calf; this should be removed quickly so that the calf can breathe freely. If the cow refuses to lick her calf after calving, the attendant needs to rub the calf vigorously with a dry sack. After calving it is advisable to avoid milking the cow dry for two or three days, or until danger of milk fever is past. When all is known to be normal her ration can be gradually increased so that she is on full feed in about 2 weeks.

Feeding Cows in Milk

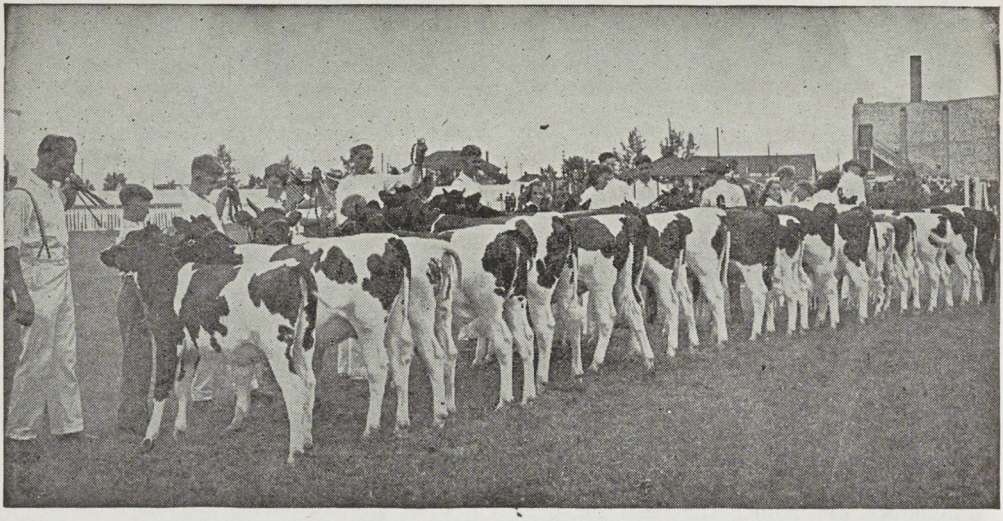
Milking cows should be fed as individuals. A satisfactory rule in making up rations for dairy cattle is to feed roughage according to the body weight, and concentrates according to production. Roughage should be fed at the rate of 2 pounds of dry roughage per 100 pounds of the animal's live weight, and concentrates at the rate of 1 pound for every 3 to 5 pounds of milk produced daily. By such a rule, a 1200-pound cow giving 35 pounds of milk daily should receive 24 pounds of dry roughage and 7 to 11 pounds of grain mixture daily.

The roughage used determines the kind of concentrates necessary. Alfalfa and clover hays fit in very well with a mixture of cereal grains. Prairie hay, tame grass hay or oat sheaves require the addition of some high protein feed, such as bran or oil cake meal, to the home-grown grains. A mixture composed of bran, ground oats and ground barley or crushed wheat, in equal parts by weight, has given widespread satisfaction. In the absence of bran an addition of ½ pound to 1 pound oil cake meal in the ration along with cereal grains will take care of the needs of most milking cows. The addition of bran or oil cake is most important when cows are producing over 40 pounds of milk daily. Nothing can be more practical and effective in improving rations for milking cows than the provision of alfalfa hay, and farms on which a field of alfalfa is established will be much better equipped for dairying. Alfalfa has much greater usefulness as hay than as pasture.

During the pasture season, cereal grains are seldom necessary except when the grass is poor. Under such circumstances the milking cows should get from 2 to 6 pounds a day of an average grain mixture. Grain for dairy cows should be ground or crushed, but fine grinding of the roughage is of doubtful value.

A number of nutritional diseases, including rickets and bone-chewing, can be traced to a shortage of minerals in the feed. When such a deficiency is suspected it is advisable to provide some edible bone meal which can be included in the grain mixture at the rate of 1% to 1½% by weight, or placed in a box or hopper where the cows can eat it at will. Mono-calcium phosphate as a carrier of calcium and phosphorus, can be used instead of bone meal.

The value and importance of common salt in the ration is well known. Dairy cows require about 1 ounce of salt a day.



Members of Dairy Calf Clubs exhibit their 8-12 months old calves in a Provincial Sweepstakes Competition. An illustration of uniformity, good dairy type, and skilful care and feeding. The careful raising of dairy heifers from tested sires and dams is one of the cornerstones of a successful dairy business.

It is the practice on some farms to mix 1 pound of salt with each 100 pounds of grain fed, and, at the same time, allow the cows access to additional loose or block salt.

Herd Sire

Exercise is essential to the health, thrift and continued use of the herd sire. The sire's feet should be trimmed at least once a year. The hoof should be trimmed from the under side so as to form a level bearing surface. When the outer edge is cracked or badly formed, it will be necessary to trim the edge with pincers and a coarse rasp.

Fly Repellants

Flies annoy the cows and cause decreases in milk production. Any good commercial livestock fly repellant may be used to afford protection.

For further information see sections on Animal Diseases, page 142, and Insect Pests of Livestock and Poultry, page 106.

MINERAL SUPPLEMENTS

Contrary to the claims made by many salesmen of mineral mixtures, there are only four or five minerals that are likely to be deficient in farm rations. As animals rarely suffer from lack of more than one or two of these at a time, a good case cannot be made for the complicated mineral mixtures which frequently sell at high prices.

Cattle, sheep, horses and pigs are likely to require common salt and the appetite is usually a good guide to the quantities required. Cattle, especially those which do not get much grain, may need supplemental phosphorus, and bone meal or mono-calcium phosphate should be supplied. The same is true of sheep. Cows in milk may require calcium and phosphorus in added amounts and either of the above supplements would be appropriate. With pigs it is different and a good grade of ground limestone (high calcium) is the most suitable supplement. It should be provided, especially for growing pigs and pregnant and nursing sows which are not receiving the recommended allowance of skim milk, buttermilk or mixed protein-mineral supplement. Suckling pigs restricted to indoor pens in winter or early spring may need an iron supplement to prevent anemia. Pregnant sows, ewes and mares should get iodine in the form of potassium iodide during the latter half of pregnancy. The amounts of each of these supplements are stated under each class of livestock. It is possible that there are some areas in the Province in which a cobalt deficiency may exist. If this is suspected cobaltized salt may be sup-

plied. The need for extra mineral matter is specific and only those elements that are required need be fed.

Without sufficient vitamin D animals cannot utilize calcium and phosphorus and many cases of bone deficiency may reflect the absence of vitamin D as much as lack of the minerals. Summer sunshine is a valuable source of vitamin D, but during the months of November, December and January when the sun is low, it may be necessary to furnish this substance in supplemental form. Good, sun-cured hay is a valuable source of vitamin D, but one of the fish liver oils is most satisfactory as a supplement. The use of one of the fish oils will greatly benefit growing pigs and perhaps dairy cattle during winter months. There is growing evidence of the need for vitamin A supplements in winter feeding. Tested fish liver oil is the most widely used supplement.

GESTATION TABLE

Animal	Duration of heat (Days)	Intervals between successive heat periods (Days)	Length of gestation period (Days)
Mare	3-9	17-30; av. 23.5	340
Cow	½-2	15-25; av. 20.5	280
Ewe and Goat	½-2	15-20; av. 16.5	145 (Merinos 3-5 days longer)
Sow	2-3	17.23; av. 21	114
Bitch	10-14	4-6 months	60
Cat	5-10	4-6 months	55

DAIRYING

CARE AND MARKETING OF DAIRY PRODUCTS

Dairy products are an important factor in the total agricultural production of the Province. The dairy cow supplies a fairly large percentage of the food for most farm homes and on more than half the farms she also provides some cash revenue through the sale of milk or cream. Good milk cows can be kept to advantage on most farms in the Province.

MILKING AND THE CARE OF MILK AND CREAM

The Importance of Cleanliness.—Cleanliness is the foundation of good dairying. The quality of the final product, milk, cream, cheese or butter, is largely dependent on the care given in the initial stages of production.

It is not necessary to have special equipment to produce clean milk. It is necessary only to understand and apply certain fundamental principles. Milk spoils or deteriorates in quality as the result of bacterial action. Normally, there are very few bacteria in milk when taken from a healthy cow, but it is exposed to contamination immediately after it leaves the udder. Deterioration starts at this time, and continues until the final product is consumed. The chief sources of bacterial contamination of milk are the utensils, hairs and dust from the cow, dust in the air of the barn, and the hands of the milker.

It is customary to strain milk. When this is done a sanitary strainer utilizing a single service lintine type disc should be used. Straining will not reduce the bacterial contamination or improve the keeping quality of milk.

Cleaning Dairy Utensils.—Unless the utensils are carefully cleaned and sanitized, they will constitute a serious source of bacterial contamination of the milk. ("Sanitize" implies the maximum destruction of bacteria which may be expected under practical farm conditions.) Experiments have shown repeatedly that the utensils are the major source of bacterial contamination on most dairy farms. The correct washing of the utensils is not difficult, but the procedure should be standardized and followed conscientiously. There are four distinct operations to be followed in the handling of metal utensils, cans, pails, and the metal parts of cream separators and milking machines. These are rinse, wash, rinse again, and sanitize.

(1) Rinse.—The first rinse is intended only to remove the visible milk from the utensils. This should be done promptly because any delay makes the operation more difficult. Rinsing should be done with lukewarm or cold water, but never with hot water. Hot water tends to coagulate the milk solids and make their subsequent removal difficult.

(2) Wash.—After rinsing, wash each piece in hot water to which an improved type of dairy cleanser has been added. Use a brush for washing—not a cloth. The cream separator should be washed each time it is used. Washing only once a day is unsanitary. In addition, the acids formed by bacterial action in the bowl may cause some damage to the metal. The rubber ring of the cream separator should also be washed thoroughly and left on a flat surface. Hanging the ring on a nail or peg tends to stretch and distort it. With the newer types of dairy cleansers the cream separator can be washed with much less labor than was formerly required.

(3) Rinse Again.—After washing, rinse the utensils again in hot water to remove any remaining cleanser. If the water used for rinsing is hot enough, the utensil will dry quickly and no wiping should be needed. The utensils should be kept clean and dry until sanitized immediately before use.

(4) Sanitize.—**Immediately before use all utensils must be sanitized in some manner.** This can be done efficiently on many farms by placing the smaller utensils into a large one and filling the latter with boiling water. Leave immersed for about five minutes.

If chlorine sanitizing agents are used, it is important to remember that these products are efficient only when used at proper strength and on **clean utensils.** Manufacturers' directions for use as shown on packages or containers should be carefully followed. Chlorine solutions act faster when hot than cold, therefore all equipment should be rinsed in hot (but not boiling) chlorine solution, which can later be used to good advantage in preparing cows for milking. Chlorine compounds are available from dairies, creameries and dairy supply houses.

Cleaning the Milking Machine.—The following simple and effective method is recommended for cleaning the milking machine.

Prepare a stock solution of lye as follows: Slowly add the contents of a 13-ounce can of lye to a gallon of water in a glass or earthernware jar with gentle stirring. Store in corked bottles. The solution to be used for cleaning the milking machine is made by adding one cup of this stock preparation to a gallon of water.

Immediately milking is completed draw three gallons of clean cold water through each unit of the machine before the vacuum pump is shut off. If this is done at once practically all the milk solids are removed. Delay in rinsing may make the whole scheme a failure. Next, take apart all the milk tubes, teat cup inflations, valves and pail head; then brush thoroughly in a warm dairy washing solution. Rinse all parts with clean warm water to remove the washing solution and scald with boiling water. The teat cup assembly requires further treatment. After the washing treatment put the assembly on a rack, clamping the long rubber tube with its opening up and at the same level as the top of the teat cups. Fill with diluted lye solution and leave until next milking. The metal parts of the machine must not come in contact with the lye. Just before milking drain out the lye solution, and the machine is ready for use.

Reducing Contamination During Milking.—There are a few simple practices which, if followed, will greatly reduce contamination of the milk. First, see that the cows are clean. There should be no loose hairs on the udders or flanks. Keeping the udders and flanks clipped is an important aid to cleanliness. Careful brushing is usually all the cleaning required when the cows are kept clipped. Under no circumstances should dirt be allowed to accumulate on the udders and flanks. The hands of the milker should be thoroughly washed just before milking commences and milking stools which are handled during milking must be kept clean. The practice of wet milking should be eliminated. Not only does it increase the contamination of the milk but it also tends to cause chapping of the teats, particularly if the cows are allowed outside.

Cows suffering from sore teats or mastitis (garget) should be milked last. The hands of the milker should be washed and dipped in chlorine solution after milking each such cow.

Keep the air of the barn as free from dust as possible, especially during milking. Handling dry feed, cleaning the barn, or brushing the cows just before milking tends to increase the amount of dust in the air and hence to increase the contamination of the milk from this source.

Prompt and Thorough Cooling.—Bacteria multiply rapidly in milk, particularly if it is warm. This growth can be greatly reduced by cooling milk or cream to a temperature of 50 degrees F. or lower. Prompt and rapid cooling is essential for the production of high quality milk and cream and should be done as quickly as possible during all seasons of the year. Place the container of warm milk or cream in cold water and maintain it at a temperature under 50 degrees F., but above freezing point, until delivered to market. **Do not guess the temperature, use a dairy thermometer.**

Air is a very poor cooling medium. For this reason it is essential that milk or cream be cooled thoroughly in running water, or ice water, before placing it in the ice well. If cans are cooled by setting in ice water, the cooling is hastened by keeping the water in motion by frequent stirring or otherwise. The ice well is a splendid device for holding cooled products, but it should not be used as a substitute for preliminary cooling of milk or cream.

Occasional stirring of milk or cream while immersed in water hastens cooling, but great care must be observed not to introduce contamination by using a soiled or dusty stirring rod. Never remove the cover from the can in a dusty atmosphere.

A bulletin giving complete information concerning methods of "Cooling Milk and Cream on the Farm," may be secured on application either to the Extension Department, University of Saskatchewan, or the Dairy Branch, Department of Agriculture, Regina.

Avoiding Feed Flavors.—Milk should be removed from the barn promptly. When cows are feeding upon green grass, wild or tame, there is a tendency for the milk to take on a "feed" flavor. This can usually be eliminated by taking the cows off the pasture about three hours before milking. Stinkweed imparts a very disagreeable flavor to milk. This flavor becomes concentrated in the cream and persists in the butter. The flavor of this weed is also imparted to milk when the cows are allowed to eat stinkweed seeds. All accumulations of

Time Required to Cool Milk to 50 Degrees Fahr. Using Running Water and Still Air as Cooling Media

The milk was cooled in eight-gallon cans. The temperature readings were taken from the centre of the can.

TIME (Minutes)	RUNNING WATER (43°F.)		STILL AIR (-5°F.)	
	Milk Stirred (Deg. Fahr.)	Not Stirred (Deg. Fahr.)	Milk Stirred (Deg. Fahr.)	Not Stirred (Deg. Fahr.)
0	104	104	104	104
10	89	91	97	98
20	72	79	92	94.5
30	61	72.5	88	91
40	55	68	84	88.5
50	52	65	80.5	86
60 (1 hour)	49	61	77	83
70	—	57	74.5	80
80	—	54	70	77
90	—	52	66	75
100	—	51	64	72
110	—	50	61	69.5
120 (2 hours)	—	—	59.5	67
130	—	—	57	65
140	—	—	55	63
150	—	—	53.5	61
160	—	—	52	59
170	—	—	50.5	57.5
180 (3 hours)	—	—	49	55.5
190	—	—	—	54
200	—	—	—	53
210	—	—	—	52
220	—	—	—	51
230	—	—	—	50

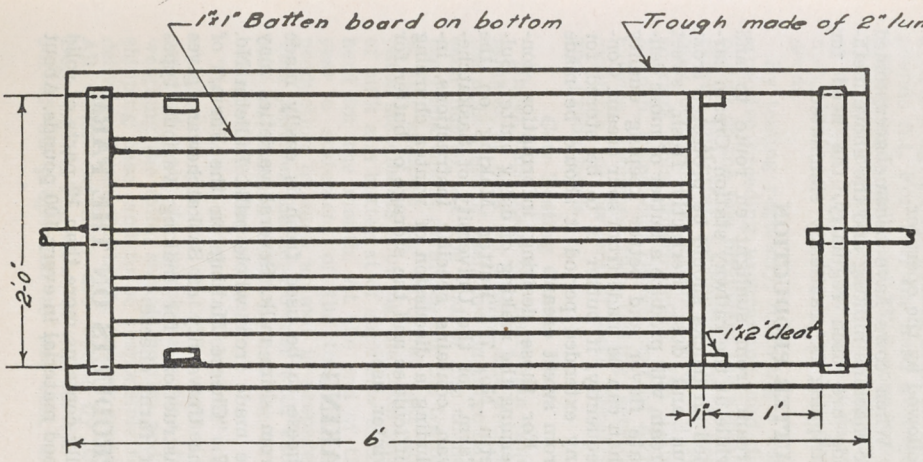
weed seeds around the threshing sites should be removed and destroyed promptly. For further information on the control of weeds which produce off flavors in milk and cream see section of the "Guide" entitled "Weed Control." When stall feeding, the use of strong flavored feeds, as turnips, weedy hay, etc., should be avoided for at least two hours before milking. Such feeds may be used immediately after milking.

Safe Milk.—Milk produced under unsanitary conditions or coming from diseased cows may be a menace to the health of the consumer. Cows suffering from tuberculosis, contagious abortion, actinomycosis (lump-jaw), certain forms of udder infections or any other disease that may cause illness in man, should be removed from the herd. If there is any doubt as to the safety of the milk for human use it should be either pasteurized or boiled. Pasteurization consists of heating milk to 145 degrees F. and holding it at this temperature for 30 minutes. If the boiling method is preferred, keep the milk at the boiling point for two minutes in a covered vessel. Milk treated by either of these procedures should be cooled to at least 50 degrees F. as quickly as possible.

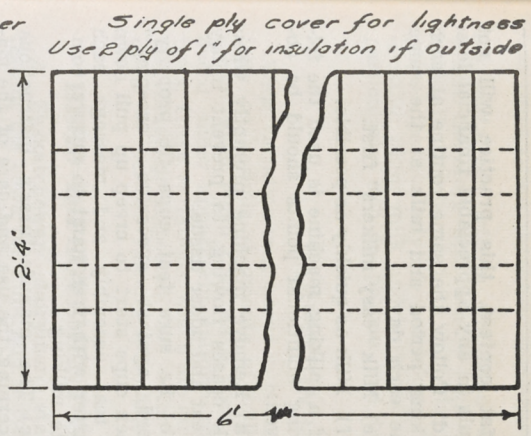
PROPER MILKING PRACTICES

Mechanical milking is regularly practised on many Saskatchewan farms today and the use of milking machines is steadily increasing. Machines properly installed and operated will milk efficiently, without injury to the cows, and at a great saving of time and labor. Under conditions of labor shortage and high labor costs, machine milking may be profitably employed in herds where 10 or more high-producing cows are regularly in milk. It has been amply demonstrated that clean, wholesome milk, meeting the highest sanitary standards, can be produced by machine milking.

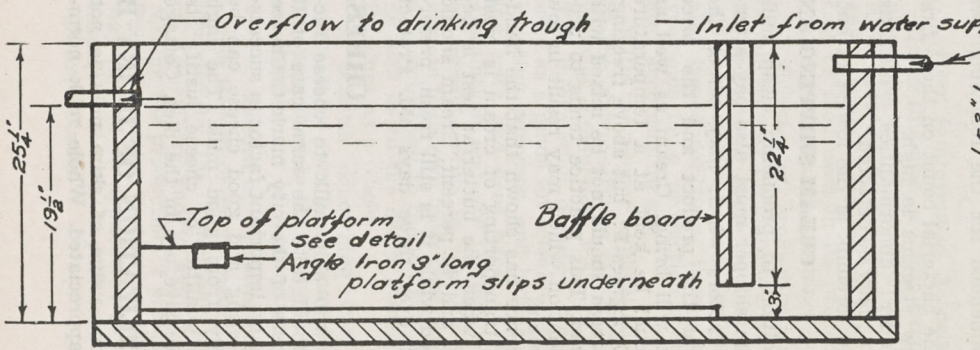
Recent studies on milk secretion have shown that the process of "letting down"



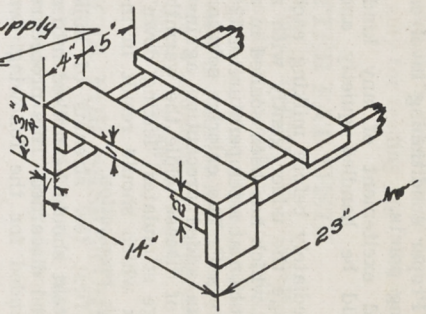
PLAN



TANK COVER



VERTICAL SECTION



DETAIL OF PLATFORM
FOR 5 GALLON CAN

COOLING TANK FOR MILK & CREAM

milk is under the control of the cow's nervous system. Consequently, cows should be conditioned for milking whether hand or machine milking is employed. Proper conditioning involves the following points.

(a) Avoid excitement of any kind. Cows should be handled quietly and gently.

(b) Immediately before milking each cow, massage the udder gently with a damp towel which has been soaked in a chlorine solution at a temperature of 120 to 130 degrees F. The chlorine solution serves as an added precaution against the spread of disease while the warmth and massage stimulates "letting down" of the milk which should result in increased milk production.

(c) The first few streams of milk from each teat should be milked into a strip cup and discarded. This procedure is recommended for the following two reasons:

(1) The bacterial count on these first few streams is high.
(2) Udder abnormalities, mastitis, etc., may be detected.

Since the foremilk is the lowest in butterfat content, this practice will not result in any appreciable financial loss.

(d) Follow the same routine at each milking period and milk at the same time each day.

(e) Milk "easy milkers" first.

(f) Milk as quickly as possible.

If a milking machine is used the following additional points should be observed:

(a) Remove machine promptly when milk ceases flowing, to prevent injury to teat and udder tissue.

(b) Be sure teat cups fit properly. Guard against excessive "creeping." When cups start to creep up pull down on teat assembly and massage each quarter with free hand to ensure complete milking.

(c) The manufacturer's instructions concerning the use and care of the machine should be studied and carefully followed by the operator.

When cows have become accustomed to machine milking and the above methods are used regularly, the need for stripping is practically eliminated.

CREAM SHIPPING AND BUTTER PRODUCTION

In addition to producing clean milk the cream shipper must also pay attention to factors which may affect the quality of the product and the price which it will bring. Cream as well as milk should be kept at a temperature below 50 degrees F., but above freezing. **Warm cream should not be mixed with cold cream.** This practice tends to produce oxidation which may result in low grade cream.

Experience has shown that the handling and transporting of cream is most efficient when the butterfat test is between 30 and 40 percent. Cream should be shipped while it is still fresh, preferably not over three days old. Protect cream from sunlight en route to and while at the railway station. Cream carried on trucks should be protected from sun and dust. Perfectly fresh, sweet cream will produce a butter of more delicate flavor and better keeping quality than can be made from sour cream. Consequently, if butter is to be stored for any extended period it should be made from sweet cream.

For those desiring information concerning the making of dairy butter, Bulletin No. 7, "Butter Making on the Farm," of the University of Saskatchewan, contains specific instructions, including a discussion of winter churning difficulties and the storage of butter for winter use.

CHEESEMAKING

Those who ship milk to cheese factories should take the same care of it as suppliers of the city market. Cheese quality is an important factor in successful marketing and good cheese can be made only from good milk. The high nutritive qualities of cheese justify its more extensive use in the diet. Cottage cheese to be used fresh is easily made from skim milk. Several varieties may be made from whole milk. Bulletin No. 17, "Cheese Making on the Farm," of the University of Saskatchewan, gives instructions for making various types of farm cheese.

UTILIZATION OF DAIRY BY-PRODUCTS ON THE FARM

The food value of skim milk is not always appreciated. Whole milk normally contains more than 12 parts of solid food material in every 100 pounds. About

8.5 parts are left in the skim milk, which therefore still has a high food value. It may be used for domestic purposes, particularly for drinking and cooking. Skim milk and buttermilk are particularly rich in protein and bone-building minerals, and are of special value in balancing rations. Surplus skim milk, buttermilk or whey, in conjunction with other feeds can be used profitably for feeding pigs, calves and poultry.

VARIATION IN BUTTER FAT TESTS

Wide variation may occur in butterfat tests on various shipments of milk or cream, even when they have been produced under apparently uniform conditions. These variations, which are normal and must be expected, are often the cause of serious misunderstanding between shipper and purchaser. The causes of these variations are fully discussed in Bulletins Nos. 82 and 103 of the University of Saskatchewan and in Circular No. 6 issued by the Department of Agriculture, Ottawa.

HERD IMPROVEMENT SERVICES FOR SASKATCHEWAN

A Saskatchewan dairyman started testing his cows for milk and butterfat production in 1941 and for that year his herd averaged 6,405 pounds milk and 245 pounds fat. For 1947 his herd averaged 9,634 pounds milk and 332.6 pounds fat. This producer states most emphatically, as do many other Saskatchewan dairymen, that **cow testing pays big dividends.**

By testing regularly, following a constructive breeding programme, and disposing of the low producers the average yearly butterfat production of a herd may be considerably increased. To encourage this improvement the Dairy Branch, Provincial Department of Agriculture, sponsors two testing services available for owners of both purebred and grade herds.

Cow Testing Centre Plan

Under this plan, the dairyman takes samples of milk for testing and records the milk yield of each cow on three days each month. At the end of the month the Department arranges for the testing of the samples for butterfat and prepares statements showing the total yield of milk and butterfat of each cow in the herd for the month. At the end of the year a statement of the total annual production of each animal is prepared. This provides the herd owner with valuable information which he can use as a basis for herd improvement.

The amount of labor involved is very small as is also the cost. The farmer is required only to purchase scales for weighing the milk, sample bottles and a shipping case, and to be responsible for delivery of samples to the testing centre. All other expenses are borne by the Department. The value of this service is out of all proportion to the cost and effort involved and it is strongly recommended that more farmers make use of it.

Herd Improvement Association

Under this plan, a Dairy Recorder employed by the Department of Agriculture, determines the quantity of milk and butterfat produced by each cow, the cost of feed used in its production and the ultimate income obtained.

Certificates of production are issued on all records of mature cows showing 360 pounds or more of butterfat in a 305-day lactation period. Certificates are also issued for two-, three- and four-year-olds on a production scale graduated according to age.

With the proper application of either of the above services efficient and economical production may be obtained. The information obtained may also be used as a guide for selecting animals for breeding purposes, and buying and selling cows and herd sires. A number of associations and cow testing centres are at present active in this Province and have in their own individual cases proved a distinct asset to the individual member as well as to the dairy industry of the Province as a whole.

A bulletin concerning Cow Testing under these two plans may be secured on application to the Dairy Commissioner, Department of Agriculture, Regina.

Record of Performance

The Record of Performance service is provided by the Dominion Department of Agriculture and is available for recording the production of purebred cows. Full information concerning this service may be had on application to the Chief Inspector, R.O.P., Department of Agriculture, Ottawa.

POULTRY

The poultry flock on the farm ought to be an integral part of the farm enterprise and should be given the same careful thought and planning as that given to crops and livestock. Poultry keeping can never be interesting or remunerative until good management practices and sound business principles are applied to it.

Many farm flocks are not as profitable as they should be because they are too small. There will always be a place for the family flock, large enough to supply eggs and meat for the farm family with some surplus at certain seasons of the year. With these flocks, it is often a question as to the profitableness of many practices which are known to pay under commercial or semi-commercial conditions. There are many flocks large enough, however, to become an efficient unit on the farm. Such flocks, to be really profitable must produce a large number of eggs per hen, per 100 pounds of feed consumed, and per hour of labor expended. Costs are then reduced to such an extent that there is a reasonable margin of profit. A proposal for an efficient farm flock unit is outlined below.

An efficient poultry unit is 500 unsexed chicks or 250 pullet chicks.

Essential Equipment for Such a Flock

1. BROODING PERIOD:

2 portable brooder houses—each 10'x12'.
2 brooder stoves—oil or coal—with a 4½' or 5' canopy.
6 five-foot feed hoppers.
8 one-quart water fountains.

2. REARING PERIOD:

2 range shelters—each 10'x12' (for the pullets). Use brooder houses for the cockerels.
6 range feed hoppers.
4-6 water fountains (depending on size).

3. LAYING PERIOD:

1 insulated house—20'x40' divided into 2 pens.
4 five-foot laying mash hoppers.
4 ten-foot grain troughs (made of 1"x6").
3 roosts (2"x4") in each pen, with droppings board or droppings pit.
4 community nests.
4 containers for oyster shell or limestone grit.

4. FINISHING PERIOD FOR COCKERELS:

Crate or pen for fattening.

Starting with 500 day-old chicks, you can expect:

An average mortality of 10%.
To cull 10% in the fall. These are marketed.
To have 200-210 pullets for the laying house.
To market 200-220 cockerels.

NOTE: Where only pullets are purchased, the amount of equipment necessary for the brooding and rearing period will be one-half the amount stated above.

The three factors which contribute to poor returns from a flock of hens are (1) seasonal production (2) low quality product and (3) out-of-date methods of management.

Before a flock can become profitable the birds must be (1) good layers (2) carefully reared (3) comfortably housed (4) properly fed and (5) kept free from disease. Once the eggs are laid or the poultry produced, careful attention must be given to handling and marketing.

The importance of the foregoing statements can be illustrated by indicating the reduction in production costs through higher flock averages. A hundred hens laying at the rate of 60 eggs per day will eat about 27 lbs. of feed daily. The same number of hens laying 24 eggs per day will consume about 22 lbs. of feed per day. In the first case 5 2/5 lbs of feed was used in producing one dozen of eggs while in the second flock one dozen eggs required the consumption of 11 lbs. of feed. More eggs per hen is probably the best answer to higher feed prices since feed costs represent about ⅔ of the total cost of producing a dozen eggs.

PLANNING THE PRODUCTION PROGRAM

Poultry production practices should be related to the market requirements. Since there is a steady all year round demand for fresh shell eggs and fresh killed poultry meat for domestic and export purposes, producers should be interested in developing a new poultry program to meet these demands.

This new program calls for the production of a large number of eggs from early September to the end of January. In order to have pullets grown and ready to lay throughout the period of best prices, earlier hatching becomes a necessity. Chicks hatched in March and early April are recommended. In a well planned program the flock owner will have his brooding well in hand before the rush of spring work. When purchasing baby chicks it is well to remember that the number of eggs which a hen is capable of laying is first of all determined by her inheritance. Well bred chicks are essential to a well filled

egg basket. These chicks should be produced from eggs laid by flocks whose production index is above the average and they should possess other desirable economic qualities such as fast feathering, rapid growth, low mortality, high hatchability, desirable market type and good egg quality. The breed of chicks chosen is not nearly as important as the breeding background of stock from which they come. There are four grades of chicks, listed in order of breeding value. R.O.P. (purple label) R.O.P. pullet, R.O.P. sired (red label) and Approved (blue label). The chick buyers have the choice of purchasing either sexed or unsexed chicks. With Leghorns there may be some merit in buying pullets only, but as far as the heavier breeds are concerned a combination of meat and egg production is recommended. Experiments have demonstrated that the raising of cockerels is profitable because the return from the sale of these male birds as 5 or 6 pound well finished roasters has been sufficient not only to pay for the feed required to raise them but also enough to pay for the feed consumed by the pullets. Thus the pullets are practically paid for by the time they start to lay.

CAREFUL BROODING RESULTS IN PROFITABLE POULTRY

The brooding and rearing periods in the life of a chicken are of the utmost importance. High grade chicks with all the advantages of good breeding can be purchased but they must be carefully raised to maturity to have well developed pullets to place in the laying house in the fall. Many chicks of good quality are ruined each year by faulty brooding and rearing methods when a little care would have produced well developed birds. Careful brooding means getting the chicks away to a good start without chilling or overheating.

Suitable Housing and Equipment are Necessary. If only 30-50 chicks are to be raised, it will be found more convenient and economical to use broody hens; however, if more than this number are to be raised, artificial means must be employed. An efficient unit for the brooding of chicks on the farm consists of a portable colony brooder house (10'x12'), equipped with a coal, oil or wood burning brooder stove and canopy and a number of chick feeders and waterers. A brooder house of this size will accommodate 250 chicks to six weeks of age. Not more than 300 chicks should be brooded under one cover regardless of its rated capacity. The capacity of a brooder house is figured at two chicks per square foot of floor space.

Before the chicks arrive give the brooder house a thorough cleaning, using a scraper on the floor, followed by a good scrubbing, using a disinfectant such as ½ lb. of lye to 10 gallons of boiling water. The walls and ceilings should be washed as well, and whitewashed. Start the brooder stove a week before receiving the chicks in order to ensure that the house will be thoroughly dry and the brooder stove adjusted and operating properly. Chaffy or cut straw, planer shavings or peat moss can be used as litter on the floor and should be changed weekly.

Keep the Chicks Warm and Comfortable. Overheating can be just as disastrous as chilling. A brooder thermometer is essential and should be suspended at the edge of the canopy, two inches from the floor. Maintain a temperature of 95°-100° for the first week and gradually decrease this temperature 5° per week for the remainder of the brooding period. A chick guard is necessary for the first week or 10 days to keep the chicks close to the source of heat, this can be moved back daily until it is discarded. Maintain a temperature of about 70°-75° in the brooder house. The chicks themselves should be watched closely—if they are huddling close to the brooder stove, the temperature is too low and if they are around the walls of the house, the temperature is too high. Some heat is required until the chicks are well feathered.

What to Feed. A good quality commercial chick starter should be fed for the first six weeks. One hundred chicks will eat 200 pounds of starter during this period. At first the feed can be sprinkled on shingles or pieces of cardboard, but after the second day use proper feeders. Allow five feet of feeding space for each 100 chicks. This should be doubled after two weeks. Fill the feeders daily with fresh starter mash. Give water to drink. Provide at least two one-quart drinking fountains for each 100 chicks at the start. Clean these daily. It should not be necessary to add any disinfectant or other material to the drinking water. After six weeks, change the chicks from starter mash to growing mash. Also

introduce a small amount of grain. At this age, they can be allowed to run outside on a clean grass pasture, provided that a suitable enclosure is built to keep them from wandering too far from the brooder house.

Supply Clean Range. From the time the birds are well feathered until maturity they should be reared on good, green range entirely separate from adult stock. Clean range means ground that did not have chicks on it the previous year. An excellent system is to use range shelters for the pullets and the portable brooder house as a shelter for the cockerels. These buildings should be moved to a range area that will supply plenty of green feed and that has been free of poultry for three years. Large bodied, healthy pullets can be raised on good grass or alfalfa pasture plus a little whole grain, fed daily along with limestone grit.

Management. Watch out for toe picking and feather pulling. This is usually an indication of overcrowding. Get the chicks outside or into roomier quarters as quickly as possible. Teach the chicks to roost early. Two inch by two inch roosts can be used at or near the back of the brooder. Place them quite close to the floor. At about eight weeks separate the cockerels and pullets. Keep every piece of equipment as clean as possible.

HOW TO TELL THE GOOD LAYERS

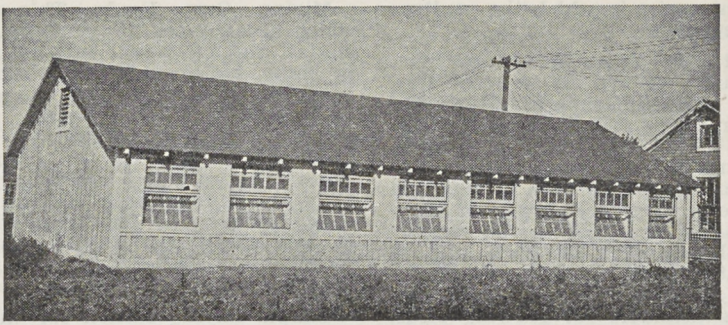
Culling is one phase of the poultry business every poultryman must learn if he is to obtain the best results from his flock. Culling should commence as soon as the chicks arrive and should continue throughout the life of the flock. Weak or crippled birds ought to be removed as soon as they are noticed. At the time the pullets are housed in the fall only those which are well grown and free from physical defects should be given housing space. As the laying season advances, there will be certain birds which do not lay their full share of eggs. Such birds might better be marketed. The main differences between a poor layer and a good producer are shown in the following chart.

Cull Hen	Part of body	Good Layer
Shrivelled, dry, pale	Comb and wattles	Large, red, waxy
Coarse, long, fat	Head	Refined, short, bright
Small, sunken	Eyes	Prominent, bright
Small, round, dry	Vent	Large, moist, oval
Thick, hard, close together	Pubic bones	Thin, wide apart
Yellow pigment in vent, beak, shanks	Color	Pigment bleached
Thick, coarse	Skin	Thin, soft
Round, coarse	Shanks	Flat
Narrow	Back	Broad
Shallow	Body	Moderately deep
Crooked or short	Keel	Straight, long
Early	Moult	Late

Towards the latter part of July or early August a final culling should be made. Specialized breeders will likely keep over the best of the old hens, but the average flock owner would be well advised to sell all his older birds and replace his whole flock with pullets. There are three advantages to this practice. (1) It gives the flock owner about a month to clean and prepare the laying house for the pullets. (2) More eggs are produced in the fall months. (3) There is definite reduction in the losses from disease infection.

WINTER COMFORT MEANS WINTER EGGS

A good poultry house should provide adequate space for the birds. Four square feet of floor space per bird for the heavier breeds and 3½ square feet for the lighter breeds is sufficient. A pen 20′ wide and 20′ long with a 6′ ceiling is recommended for 100 birds. For best results, a poultry house should be so constructed that there is maximum conservation of the heat given off by the hens. This is accomplished by insulating the walls and ceiling. Either 2x4's or 2x6's may be used as studs, with paper and siding on the outside and shiplap for sheeting on the inside. This provides a space between the studs which is to be filled with some insulating material such as planer shavings or chaffy straw.



This farm poultry house is 20 feet wide and 40 feet long and will house 200 hens. A house of this style can be ventilated easily by any one of the recommended systems of ventilation.

There are three kinds of flooring material—cement, wood and dirt. The cement is best, but it must be insulated from the underlying ground; otherwise it will be damp and cold in the winter. Six inches of gravel or cinders under the cement provides good insulation. Board floors are generally used in the brooder house. The dirt floor is the cheapest but it is difficult to keep clean, and if disease breaks out, it is impossible to practise proper control measures.

Ventilation. Proper ventilation combined with good insulation will do much to solve the problem of dampness. A hen uses more air in proportion to her size than other farm animals. For each pound of live weight, the hen breathes about three times as much air in a given length of time as does the cow. There are numerous systems of ventilation in use. Three have given satisfactory results. First, the straw-loft, cotton-front system. This results in a relatively cold house, but it requires very little adjustment. The second is the flue outlet system which maintains a higher inside temperature, but which requires more careful adjustment. The size of the outlet flue will depend on the number of birds in the pen. A cross-sectional area of 2½ square inches per bird is recommended. A flue 16″x16″ would be large enough for 100 birds. This flue should extend from floor level to two feet above the ridge of the roof. The air enters at the bottom. The size of the opening should be controlled by means of an adjustable slide. A flat cap should be built eight inches above the outside level of the flue. This is supported by means of the four 2″x2″ corner pieces. The flue must be insulated from ceiling level to the top. Fresh air may be admitted through tilting windows, and by a loft inlet built into the ceiling. The third system is simply a slot across the front wall above the windows. It is controlled by means of a sliding box.

Trends in Housing. The modern trend in poultry house construction is towards a wider building and with more than one storey. Instead of the conventional roosts and droppings boards, screened dropping-pits are built along the back wall. Community nests are replacing the single compartment nests. Labour is saved by using built up deep litter which is cleaned out twice a year, rather than the shallow litter generally recommended in the past.

FEEDING

The question uppermost in the minds of many poultry raisers today is whether or not it is worthwhile to market a part of the grain crop as eggs and meat. With an assured market for eggs and a reasonable price per dozen, it can be said that poultry production is still profitable, even at present day prices for grain. To obtain maximum returns for the grain fed, it is obvious that a high rate of production must be maintained throughout the greater part of the year. Much can be accomplished toward this end if strict attention is paid to the proper feeding of the birds from the time they are hatched until they are disposed of at the end of their laying year.

There are various systems of feeding poultry and the one to follow will depend upon the size of flock and the

type of enterprise in which the poultryman is engaged.

Concentrates—There are on the market products known as concentrates, balancers and supplements. These are all the same type and are formulated on the same basis. They are high protein, mineral and vitamin feeds to which are added home grown grains in the chopped form. The proportion and ratio of chopped grains to be added to the concentrate will be listed on each bag of concentrate. Follow the recommendations of the manufacturer. Concentrates are available for growing birds, laying and breeding stock but not for baby chicks.

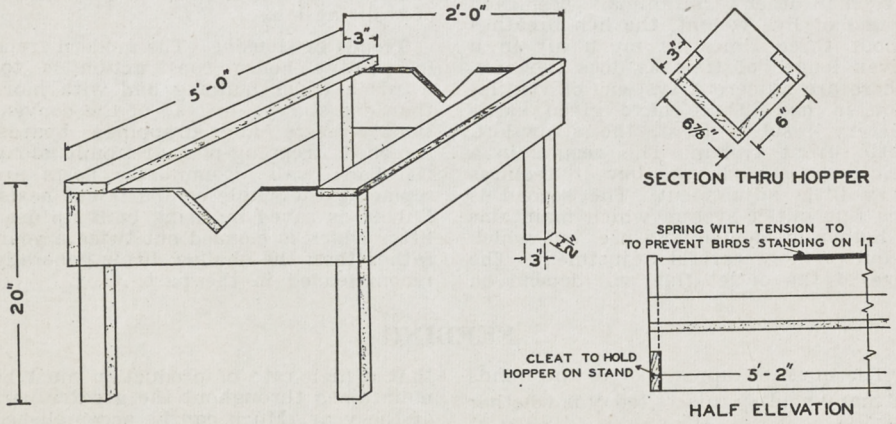
Since most poultrymen grow grains, this system of feeding would be advantageous. When the concentrate is mixed with the chopped grains, the resultant mixture is a complete mash and should be kept in front of the birds at all times.

Ready-Mixed Mashes.—Feeds of this type are complete mashes to which nothing need be added before feeding it to the birds. This type of feed is likely to be used by those who do not have any home grown grains available and would also include the commercial poultrymen as well as other types of poultry raisers.

Mixing Own Feeds.—This system, which necessitates the poultryman buying all the individual ingredients, will probably be very limited during the next few years because of the shortage of supplies. Mixing under such a situation might necessitate several changes in formula at inopportune times and may upset the birds, particularly the laying stock if they are in heavy production. For those who wish to mix their own feeds, appropriate formulae are available from the Poultry Department at the University.

Simple Laying Ration for the Small Farm Flock.—For supplying sufficient eggs for home consumption from a small flock the following mixture, which is composed almost entirely of home-grown products, is recommended: Chopped grain (wheat, oats and barley)—94 pounds; ground limestone—three pounds; steamed bone meal—one pound; salt—one pound; fish oil—one pound. This mixture should be supplemented with a forkful of well-cured alfalfa and 3-4 gallons of skim milk or buttermilk per 100 birds per day. No water should be given to drink if milk is fed. If milk is not available, 2-4 pounds of freshly ground meat per 100 birds per day may be substituted. Table scraps can be used to advantage in this simple formula.

DRY MASH HOPPER



BILL OF MATERIALS

STAND:

Legs—	4 pieces 2"x3"x20"
Sides—	2 pieces 1"x6"x5'0"
	2 pieces 1"x6"x2'0"
Platform—	2 pieces 1"x3"x5'0"

One screen door spring (may be cut in two).

HOPPER:

Sides—	1 piece 1"x6"x5'2"
	1 piece 1"x6⅞"x5'2"
Lips—	2 pieces 1"x3"x5'2"
Ends—	2 pieces 1"x7"x7¾"
Cleats—	2 pieces 1"x1"x3"

Two pieces of wire to be attached to either end of spring to hold it in place and give it tension.

Feeding Instructions.—(For feeding baby chicks see section on brooding.)

From the end of the brooding period until the pullets come into production, their feed requirements are relatively simple, particularly if they are on good pasture. After this growth is slower. This is a period for the growth of bones rather than one of muscular development. Whole grains are fed in increasing amounts. The amount to be fed will depend upon the rate of growth. By maturity, they usually are consuming twice as much grain as mash. The dry mash is available at all times, and the whole grains are generally fed in the late afternoon. Consumption varies according to the breed and sex but, on the average, they will consume about 22-28 pounds of feed per bird during this stage of growth. If the pullets are developing too rapidly, restrict the feed and provide more green pasture.

As soon as the pullets commence to lay or are housed in their winter quarters, they should be fed a laying mash in hoppers. They will consume from 12-15 pounds of mash per 100 birds per day depending upon the time of year, rate of production, and breed. Grain is fed morning and evening; it is absolutely necessary to control the amount of grain fed since the dry mash mixtures are formulated on the assumption that equal parts of mash and grain will be eaten. Thus 12-15 pounds of grain per day per 100 birds is all that should be fed. Of this total, ⅓ to ½ can be fed in the morning, and the remainder in the late afternoon, just before the birds go to roost. Feeding management is the same during the breeding period.

When the pullets commence production, it is a good practice to increase the whole grain portion of their diet up to about 15 pounds per 100 birds per day for approximately 4-6 weeks. This should help to improve body weight at this time. Adequate body weight is essential to maintain good winter production. After a month or so, reduce the amount of whole grain being fed so that mash and grain consumption are approximately equal.

Water—is more necessary than feed. Without water, birds will not survive for a very long period of time. Even relatively short periods without water have an effect on growth and especially on production and egg quality. One hundred layers will drink from 3-5 gallons of water per day.

Limestone-Bearing Grits and Oyster Shell.—Since egg shells are composed largely of calcium, additional sources are necessary for the layers. These calcium-bearing products should be available to the birds at all times in hoppers conveniently located in the pen. On the average, 4-5 pounds is required by a bird throughout a laying year.

Wet Mash.—This is one method of increasing mash consumption during the winter. Mix 3-4 pounds of dry mash with 1½-2 pounds of warm water or milk (100-110°) for each 100 birds. Vary the amount of water or milk to maintain a crumbly consistency. The most common time of feeding is noon. Usually the wet mash is fed from about the middle of November to the middle of March. This varies according to weather conditions. It is necessary to continue feeding the wet mash, if the birds become accustomed to it, until the weather breaks in the spring.

The amount to be fed will depend upon the requirements of the birds. As this is only a supplementary feeding, the dry mash should be available to the birds in open hoppers at all times.

Milk.—This is the best single feed available for chickens. It can be used to replace the water if sufficient amounts are on hand. It has been reported that birds being fed milk as well as a balanced diet are sometimes subject to scours. In such cases it is recommended that the milk be reduced to about one-half. The birds should receive water for the remainder of the day. Either fresh or sour milk or buttermilk may be fed but do not switch from one to the other.

Finishing Cockerels for Market.—To command top prices, cockerels must be properly finished before being marketed. There is a great tendency to market cockerels too early in the fall. Such birds lack flesh and finish. As a general rule, cockerels of the heavy breeds, whether slow or fast feathering, are not ready to be fattened until they are about 6½ months of age. If on running your fingers through the feathers on the back toward the head, any quantity of short pin feathers are found, then the birds are not ready—wait about two weeks or so before fattening. Two weeks is usually long enough for crate-fattening whereas 3-4 weeks is required if the birds are pen-fattened. A mixture of ground grains (two parts wheat, one part barley, one part oats with the hulls sifted out) to which has been added 10% of meat meal, is a good mash. If available, milk should be used as the mixer, two parts by weight for each part of the dry mash. The birds

are fed morning and evening, all they will clean up in 20-30 minutes. As a guide, ten birds will consume about 4½ pounds of this mixture per feeding.

Slumps in Production.—Usually a slump in production can be traced to faulty management. Avoid sudden changes in feed. Chickens are able to detect differences in color, taste and texture of feeds. When changing from one feed to another, do so gradually by diluting one with the other over a period of 7-10 days.

The overfeeding of whole grains will also result in lowered production and may lead to such vices as feather picking and cannibalism.

Sudden changes in temperature and exposure to drafts will affect production. Keep a close check on the ventilation in the house and avoid drafts at all times.

Very often, the early maturing (August and September) pullets will drop in production in November or December. Such slumps are usually associated with heavy fall production, a loss in body weight and the onset of short cold days. Any slump in production is preceded by a lowered water and mash consumption. An observant poultryman will note these symptoms and take the necessary precautions. Now is the time to commence feeding the wet mash and increase the amount of whole grain fed if body weight is a little light. If the slump is severe, a neck moult will be evident. Production will not return to normal until the feathers grow out. This may extend over a period of about six weeks. Under such conditions, good feeding management should be practised.

Feather Picking and Cannibalism.—This vice is usually caused by overcrowding or the feeding of an improperly balanced diet. Check on the amount of floor space allotted to each bird and make sure that the concentrate is not being diluted with too much chop or that too much whole grain is being fed. If feather picking is noticed in the pen, cover the affected areas of the birds with axle grease or thick pine tar. This will discourage further picking. If this condition is allowed to continue, cannibalism may develop within a day or two. It may be necessary to remove the severely picked birds from the pen for a few days so that the wounds may heal.

CARE OF EGGS AND MARKETING POULTRY PRODUCTS

A large volume of Saskatchewan's total egg production is exported. It is expected that a considerable portion of these eggs will go to Great Britain. Those that go in shell form will be stamped with the word "Canada." The British consumer will be both judge and jury, and our future in the export business depends to a large extent on the quality of the deliveries to this market. If we are to maintain our rightful place in this highly competitive business and maintain a steady market, every effort should be made to produce and market a top-grade product.

How to Produce Quality Eggs.—The quality of a fresh egg cannot be improved after it is laid, but it will lose its original quality very rapidly if not properly cared for. The following points if carefully observed, will go far towards the production and maintenance of good quality:

1. Select chicks from hens known to produce eggs of good size, shape, and color, with strong shells and firm whites.
2. Produce strong shells and moderately colored yolks by following the feeding practices outlined herein.
3. Confine the hens to the laying pen on wet days, and on other days keep them in until 3 to 4 o'clock in the afternoon.
4. Remove and dispose of the male birds after the breeding season.
5. Remove and break up broody hens immediately.
6. Keep the nests clean to prevent soiled shells.
7. Gather eggs several times daily.
8. Hold eggs in wire mesh containers in a cool place for several hours before crating. A holding temperature of 40° to 60° F. is recommended. Placing the eggs on Keyes trays could be done if wire baskets are not available.
9. Market oftener than once a week if possible, and ship direct to a registered egg grading station.

Market Poultry.—Every effort should be made to finish birds so that they are eligible for the top grades and weighing over 4 lbs. dressed. There is always a market for Grade Special Milkfed and Grade A Milkfed chickens, also Grade Special and Grade A fowl over 4 lbs. Poultry under 4 lbs. and of low grade are a drag on the market

and cut down considerably a producer's net return. Finish market poultry early and sell it direct to a processor operating a registered poultry packing station as soon as it is properly fattened.

SANITATION AND DISEASE CONTROL

Prevention and not cure is the economical method of controlling poultry diseases. The individual treatment of sick hens is seldom recommended because of the low unit value of the birds and the relatively high cost of the treatment. Control measures are applied to the flock as a whole rather than to the individual bird.

The general measures which should be adopted to control excessive mortality in a flock are usually grouped under the heading of sanitation. If chickens are provided with comfortable buildings, properly balanced rations, and not allowed to become exposed to disease infection, they will grow well and produce eggs and poultry meat at a high efficiency level. Profits cannot be made from flocks in which the mortality rate is excessive.

Sanitation in the Poultry Yard.—Soil upon which chickens have been raised continually year after year is a source of disease infection. There are many types of disease infection—some of them find an excellent place in warm damp soils where they continue to develop or lie dormant and thereby become a menace to healthy birds. Rotation of yards is the only solution to this problem. The application of lime and other such disinfectants to the infected soil is of little or no value. **Young chicks should be brooded on a new piece of ground each year.** Growing chickens need clean range. This means range which did not have birds running over it the previous year. It is an excellent idea to grow mixed annual cereals and rape on the poultry range. Do not allow young chickens to have any direct contacts with the old flock. Turkeys and chickens should not be raised together, either during the rearing period or during the winter. If the adult birds are allowed to run in the barn yard, the control of disease through soil sanitation is very difficult. If fenced yards are provided, arrange them in such a way that at least two runs are available. Pasture one yard at a time, then next year use the other yard. It is well to remember that, with the exception of one or two diseases such as Pullorum, baby chicks hatched in an incubator are comparatively free of disease. If disease develops, the infection is picked up either while the chicks are held in storage batteries, or from unsanitary brooders or infected soil.

What to Do If Disease Breaks Out In the Flock

1. Send one or two live specimens by prepaid express to the Veterinary Department, University of Saskatchewan, Saskatoon. These birds will be examined free of charge and the results of the examination, together with suggested remedies, will be sent within a day or two.

2. If the flock is running outside, get them indoors as quickly as possible, but be sure that the house is not overcrowded. Birds cannot be treated while running at large.

3. The sick chickens should be removed from the flock immediately and the dead ones burned.

4. Change the litter in the laying house or brooder pen daily until the disease clears up.

5. Check management factors which might be a partial cause of the trouble. Make sure that the feed is suitable, and that it contains the various ingredients necessary for growth and production. Consult bulletins on feeding if there is any doubt about what to feed.

6. Non-poisonous disinfectants, such as potassium permanganate, may be added to the drinking water. This helps destroy disease germs in the water, but it has little or no effect as an intestinal disinfectant. Combinations of drugs, commonly referred to as tonics for mixing with feeds, have little value in preventing or curing infectious diseases.

TURKEYS

Introduction.—Turkey raising has become an important sideline on many Saskatchewan farms. This has resulted from favourable climatic conditions as well as the availability of moderately priced feed grains.

Rapid changes have taken place in the turkey industry on the western prairies during recent years. The most important of these changes are:

(1) The development of a commercial turkey hatching industry.

(2) The wider adoption of artificial brooding.
(3) Increased interest in total confinement rearing of market turkeys.

These trends permit the farmer turkey grower to rear market turkeys without the necessity of wintering a breeding flock but open wide possibilities for the establishment of turkey hatching egg flocks to supply eggs to the commercial incubators. This latter development is regulated by the Saskatchewan Turkey Approval Policy and all enquiries in this connection should be addressed to the Poultry Commissioner, Department of Agriculture, Regina, Saskatchewan.

On many farms the income derived from a flock of turkeys is considered to be a good form of crop insurance.

The consumer demand for a **medium sized market turkey** with the highest possible percentage of edible meat has set the standard at which the industry must aim.

Breeds of Turkeys.—The particular breed which one chooses is in most cases a matter of personal preference. The common breeds found in Saskatchewan at present are Bronze, White Holland, Bourbon Red, and Narragansett. There are good and poor strains in all breeds. Those who are setting up a breeding program should secure foundation stock from a breeder who has, over a period of years, selected his birds for good market qualities, fertility, hatchability and livability.

Selection of Breeding Stock.—The problem of the selection of breeding stock will, as time progresses, be of less direct concern to the turkey grower than to the turkey breeder. It will continue to be a very important part of the program of the hatching egg shipper. Upon the type of birds selected to produce the hatching egg supply will rest the responsibility for the quality of the following season's market turkey crop throughout the Province.

The increased emphasis being placed on the development of thick breasted strains of turkeys may result in an overdevelopment of this characteristic which may produce an unbalanced bird with low reproductive ability. Many of these strains of turkeys tend to be short in both keel length and back. Breast thickness should be only one of the characteristics required in breeding stock. Good length of keel, good width and length of back, smoothness on the fore point of keel and generally good balance, as the birds walk about the pen, are very important points in the selection of breeders. Avoid the front heavy bird which is a result of excessive thickness on the fore part of a short keel. Long legged, long necked, wedge shaped birds should be sent to market. Birds which show excessive depth are also undesirable.

Care of Breeders.—Large flocks of turkeys maintained for the production of hatching eggs should be provided with clean, dry, well lighted and well ventilated quarters. An outdoor run is desirable but not essential. When totally confined the birds should be given **at least** 10 square feet per bird and preferably more. All unnecessary obstacles, which would interfere with

mating, should be removed from the pen. Nests are best constructed of the community type and can be darkened by hanging sacking down the front. A nest 2'x6' is sufficient for at least 25 hens. Nests should be provided well in advance of egg laying.

Toms are required at the rate of one for each 10 hens. It is always well to have a spare tom or two in case one or more go out of condition. The toe nails of the male birds should be clipped and filed round. Turkey saddles are necessary for protection of the females.

Well matured turkey hens can be brought into production early in the season by the use of artificial light.

Feeding Turkey Breeding Stock.—The diet fed to turkey hens has a very definite influence on the ability of the eggs to hatch and baby turkeys to live after hatching. A straight grain diet will not provide all the ingredients necessary to produce a good hatching egg.

Without artificial light the average hen commences to lay about April 1st, but she has been getting ready to lay for the previous two months. Turkey hens should be provided with a good laying mash, or better still a breeding mash during this period. Any good chicken laying mash will do as a basis, but since turkeys require more green feed and fish oil, these should be provided in additional amounts. Extra fish oil at the rate of one teaspoon per hen per day can be mixed with a warm, wet mash. Feed no more than can be cleaned up in 30 minutes. Milk is an excellent feed for good hatchability. It should be given in place of water to drink. Hatching eggs should be collected regularly and stored in a cool place. Special turkey egg fillers holding 200 eggs are available for the standard 30 dozen crate. These are much more satisfactory than using the chicken egg fillers. Eggs which are held for shipping or incubation can be turned by tilting the crate over a block of wood.

INCUBATION

For those who plan on incubating their own eggs in the ordinary coal-oil incubator the following points can be used as a guide:

Temperature.—100½ degrees the first week, 101½ degrees the second week, 102½ degrees the third week and not over 103 the fourth week with the bulb of the thermometer 1⅞ inches above the tray bottom.

Humidity.—Moisture pads, made by wrapping burlap about a lath, are recommended for the first two weeks. They should then be removed and replaced on the 24th day. They must be kept well saturated during the last four days. Turn eggs twice daily until the 21st day. Thereafter they need not be turned.

Brooding.—(See brooding chicks, page 129.)

Poults may be brooded with the hen or by artificial means. Baby turkeys are very susceptible to infection and great care is necessary to see that they are started on fresh clean land over which old stock of both chickens and turkeys have not ranged for at least two years. Keep all feeding and watering utensils scrupulously clean.

Where poults are brooded by a mother hen, she will usually teach them to eat. If they are artificially brooded it is important to see that each poult gets a few mouthfuls of water and a mouthful of feed when placed under the brooder. Many poults die during the first week because of failure to eat. Time spent with the poults at this stage is well worthwhile. Rolled oats or some other attractive material should be scattered over the mash every two hours to induce them to feed.

A well-compounded turkey starter mash is recommended for the first eight weeks. Milk is a very important feed and should be fed after the poults are well started. An abundance of succulent green feed is essential for the proper development of the poult throughout the entire summer.

Growing turkeys will make more rapid growth if provided with a balanced growing mash during summer months. Ground wheat, oats and barley will form the basis of this mash to which should be added 10 per cent commercial meat meal. This type of growing mash will be satisfactory only if abundant succulent young green feed is available throughout the growing season. Many commercial firms supply a turkey growing concentrate. As the birds grow older, increasingly larger amounts of cracked and whole grain should be fed. Whole plump oats are a good feed for turkeys. They can be induced to eat them if a few pounds are added to the starter mash beginning about the seventh or eighth week. The amount should be gradually increased during the summer. Mash and grain hoppers should be moved every few days to clean ground. The spring seeding of an acre or two of Dwarf

Essex rape will ensure late summer green feed.

Total Confinement Rearing.—This practice, where growing turkeys are reared in wire or slat floored pens, was developed to overcome the disease problem in more moist areas.

Where total confinement rearing is planned it is recommended that it be tried out in a small way until the problems can be mastered. Not less than seven square feet per bird should be allowed. A good sized area of green feed such as rape or kale should be planted in early spring. This can be cut daily and fed in the feed troughs and will assist in preventing many dietary deficiencies. Consult the Dominion Experimental Station, Swift Current, or the Poultry Department, University of Saskatchewan, Saskatoon for further information on this subject.

Finishing.—Before birds are marketed, they must be properly finished. To produce this extra finish, it is essential to induce them to eat more by the feeding of one or two warm wet mashes during the early part of the day. Finely ground grains, steeped in milk, are recommended. Where no milk is available, 5 to 10 percent of commercial meat scrap should be added to the ground grains and then moistened with warm water. Give the birds a heavy feeding of whole grain in the evening. The length of finishing period is usually four weeks.

Killing and Dressing.—Turkeys are prepared for market in the same manner as chickens. They should be picked clean and chilled, without freezing, immediately after being dressed. Well finished turkeys bruise easily and, for this reason both live and dressed birds should be handled carefully.

Approximately 75 percent of Saskatchewan turkeys are consumed in Eastern Canada. It is therefore necessary that market birds leave prairie farms not later than mid-December. In normal times, there is often a reduction in the price after this date.

DO YOU KNOW?

THAT WE PRACTISE ONLY 20-50% OF WHAT WE KNOW OF THE VARIOUS PHASES OF PRODUCTION

The following list of requirements is a useful guide in a planned poultry production program:

REQUIREMENTS	BABY CHICKS	GROWING BIRDS	LAYERS	BREEDERS
SPACE	Allow ½ sq. ft. of floor space and 7-11 sq. in. of hover space for each chick.	Not more than 400 birds per acre on good green grass or alfalfa. Raise the cockerels and pullets separately.	3½-4 sq. ft. of floor space per bird, depending upon the breed kept.	Same as for the laying stock.
FEED	Feed a chick starter for the first 5-7 weeks. Buy 200 lbs. of starter for each 100 chicks purchased.	Feed a well-balanced growing mash properly supplemented with whole grains. 100 birds will eat about 3,000 pounds of mash and grain during this period (6-7 weeks to approximately 6 mos. of age).	Depending on the rate of production 100 hens will eat 12-15 pounds of dry mash and the same quantity of grain daily. Don't overfeed the whole grain. Oyster shell or limestone grit available at all times.	Gradually change from a layer's to a breeder's mash about one month before commencing to save eggs. This is the only change in the feeding management as compared to the layers.
WATER	Remove the chill from water for the first 2-3 weeks.	Supply plenty of cool, clean water. Use a container that is easy to clean.	100 birds will drink 3-5 gallons per day, depending on rate of production.	Same as for the laying stock.
HEAT	The correct temperature is very important. Thermometer should read at outer edge of brooder 95-100° for 1st week. Reduce 5° each week until heat is no longer required. Room temperature should be 70-75°.	No heat required, but shade is necessary to protect the growing birds from the hot sun.	Artificial heat is not practical. The whole grains supply sufficient heat. It is customary to feed ⅔ of the whole grain portion in late afternoon just before birds go to roost.	Same as for the laying stock.
HOUSING	A well-insulated portable brooder house, conveniently located. Ventilation is necessary to supply sufficient fresh air. Prevent direct drafts on chicks. Take all precautions against fire.	Range shelters are ideal for summer. Move periodically to a clean piece of ground. Remove droppings and spade over ground after moving the shelter. Shift feed hoppers a few feet every week.	House should be insulated free from drafts. Provide plenty of ventilation. Birds are protected from cold by feathers. A cool, dry house is preferable to a warm, damp one. The litter will not become so damp and eggs are cleaner.	Same as for the laying stock.

ANIMAL AND POULTRY DISEASES

The following instructions and recommendations are intended chiefly for the prevention of disease, and as a guide to first-aid treatment. When a qualified veterinary surgeon is available, owners are advised to call him whenever feasible. Instructions and recommendations for the prevention and treatment of disease, whether by bulletin or letter, are, of necessity, not a complete veterinary service and should not be regarded as such by the reader.

HORSES

NON-INFECTIOUS DISEASES

Of the non-infectious diseases of horses, the following are common in Saskatchewan when management is faulty.

Colics.—There are many conditions included under this term. For practical purposes they may be divided into these categories: Acute Indigestion, Flatulent Colic and Impactions.

Acute Indigestion.—This is a condition in which there is an excessive formation of gas in the stomach. It is always serious and often fatal due to rupture of the stomach. When we consider that the horse cannot vomit (the inlet closes after the food is swallowed and the outlet is closed by the rapid formation of gas) the seriousness of the condition can be realized.

The causes are: overfeeding of grain; too much cold water; working too soon after a heavy feed; moldy feed, either grain or fodder; sudden changes of feed, especially to green feed, oats or pasture. Briefly, the symptoms are: colicky pains, attempts to vomit, distention of the body about the middle over the curve of the ribs, great distress and suffering, and short, rapid breathing. The normal rumble of the bowels is suppressed or entirely absent.

In the treatment of this condition, the quickest and surest way is to use a stomach tube and let the gas out. The tube and the skill to pass it not being available, the next best treatment is medicinal. Mix:

Turpentine—2 tablespoonfuls
Creolin—2 to 6 tablespoonfuls
Raw linseed oil or mineral oil—1½ pints

well shaken up and given in one dose as a drench. When drenching a horse, the head should be raised just high enough to allow the medicine to run back into the throat. If a horse chokes while being given a drench, the head should be lowered promptly to avoid the danger of the medicine going down the windpipe into the lungs. Medicine should never be given to horses or cattle through the nostrils.

Don't use **boiled** linseed oil as it is poisonous.

Baking soda (sodium bicarbonate) in two to four tablespoonful doses is often given by farmers. It will give relief if the stomach is not too tightly distended but if it is, the remedy increases the pressure by effervescence and there is danger of a ruptured stomach.

It is not possible to "tap" the stomach of a horse.

Flatulent Colic.—The causes and symptoms of this condition are much the same as in acute indigestion, except that the distention is between the last rib and the point of the hip, mostly on the right side. The two diseases are often combined. The condition can be relieved by "tapping" the bowel with a trocar and cannula. The point to tap is at an equal distance from the last rib, the point of the hip bone and the side projections of the backbone, on the right side. The instrument should be sterilized by boiling, the skin shaved and swabbed with alcohol or tincture of iodine. The direction of the puncture should be downward, forward and inward deep into the bowel. The core of the instrument is then removed and the gas rushes out.

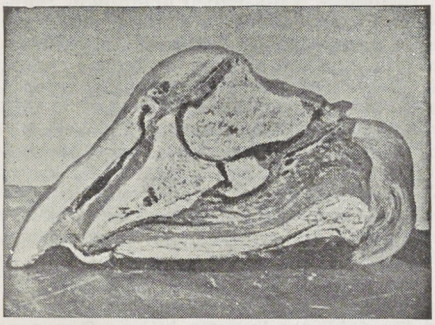
"Tapping" in the horse should be attempted only when the tension is great and professional help not available. It should never be done by "stabbing" with a knife.

The medicine recommended for acute indigestion is indicated in this condition also.

Horses suffering from either of these forms of "bloating" should not be allowed to throw themselves violently to the ground as it sometimes ruptures the stomach or bowel, which means death.

Impactions.—These accumulations of waste food material may occur at any place in the digestive system, but commonly occur in the large intestine at the constricted curve below and in front of the rectum. They are caused by lack of exercise, long continued feeding of dry feed and not sufficient water. They occur in Saskatchewan more often in the winter and early spring, among horses that have been on a diet of straw or other coarse roughages. Overfeeding will also cause them. The symptoms are: mild colicky pains, straining as though trying to urinate, dullness, constipation, often complete stoppage. The normal rumble of the bowels is suppressed or entirely absent. These symptoms may continue for days. The treatment consists of withholding all food, allowing plenty of water if the horse will drink, and giving one quart of mineral oil or 1½ pints of raw linseed oil with one ounce of turpentine well shaken up in it, the first day, then half the dose twice a day afterwards. The turpentine should not be continued for more than two days. As an added stimulant to the bowels, one teaspoonful of powered nux vomica can be given three times a day. A rectal enema of warm soapy water stimulates the bowels and should be given daily. Walking exercise is helpful.

Founder (Laminitis) is an inflammation of the sensitive structures within the hoof and usually occurs following an overfeeding of wheat or other grains. It may also occur after severe attacks of colic or following foaling. The symptoms



Cross section of a foundered foot, showing the damage done. Note the separation of the horny wall from the sensitive wall, due to the inflammation of the disease. When this occurs the weight of the body forces the last bone of the leg, like a chisel, through the sole in front of the point of the frog. In cases that recover, this separation heals but the hoof is deformed. To detect a foot that has been foundered, look for a depression in front on the wall above where the separation has healed, also a rounded prominence on the sole, in front of the point of the frog.

are extreme pain and lameness involving the front or all the four feet. The horse walks with a shuffling gait and, in severe cases, may have great difficulty in moving.

Treatment consists of applying cold applications to the feet. Stand the animal in mud or cold water for several hours at a time, then encourage the horse to lie down to take the weight off the feet. Give a physic of linseed oil or mineral oil and one level tablespoonful of saltpetre twice daily to stimulate the kidneys. Force the horse to take exercise several times daily and apply a blister to the hoof heads after the animal has been showing these symptoms for a week to ten days.

Wounds.—The main considerations in the treatment of wounds are: (1) to stop the hemorrhage if it is severe. This can be done by applying a cord very tightly, if the wound is on the legs; packing the wound with sterile gauze or tight bandaging; (2) The removal of any foreign body, splinters of wood, glass, etc.; (3) Prevention of infection. To accomplish this the following procedure is simple and useful. Cover the raw surface of the wound with gauze or absorbent cotton, soaked in an antiseptic solution, to prevent contamination while shaving or clipping the hair. Shave or clip the hair around the wound, remove debris from the raw surface, wash the wound with a warm antiseptic solution. For this purpose, use a 2% solution of lysol or creolin, or a normal saline solution (one heaping teaspoonful of pure salt to a quart of warm water). For a daily dressing tincture of iodine 2½% or mecurochrome, 1% to 2%, can be used, or the new drug, sulphanilamide, can be applied to the raw surface of the wound. This drug, or one of the same group of sulpha drugs, can be given internally if septicemia (blood poison) is threatened. They will save a great number of animals from death due to infection, but they can be dangerous given by an inexperienced person. They should be used by a veterinary surgeon only, or at least under his supervision. The still more recent preparation known as penicillin is now available for animals, and will cure many infections that used to be fatal.

With regard to suturing (stitching), the average wound does better not sutured. Suturing is necessary only if large areas of tissue are displaced or the wound is gaping.

Nail Punctures of the Sole or Frog.—Before removing the nail it is wise to

clean the sole and frog of the hoof thoroughly. Pull the nail out and pare a cup-like cavity around the point where the nail penetrated. Holding the horse's foot up, pour tincture of iodine or other reliable antiseptic into the cup and allow it to soak into the track the nail has left. In bad cases the horny frog will separate from the sensitive frog, the separation showing at the heels. In this case the point of entry of the nail should be enlarged, which makes better drainage and an antiseptic solution can be syringed through the separation at the heel. When the frog has grown a covering of new horn, the old frog should be cut off.

If a qualified veterinary surgeon is available owners are strongly advised to call him as these cases are often very serious.

Wounds and Inflammations of the Eye.—These need special consideration. The practice of blowing powdered alum or lime into the eye is cruel and often injurious. Injured eyes should be bathed with a solution of boric acid in boiled water, dissolving as much of the powder as the cooled water will take up. Afterwards a few drops of a 10% solution of neo-silvol or argyrol, or a 1% solution of silver nitrate, should be dropped into the eye with a medicine dropper, three or four times a day. An ointment containing 5% of sulphathiazole is very useful, applied to infected discharging eyes. The animal should be kept in a darkened place.

With regard to the application of remedies to the wounds of animals in general, it is best for humane reasons to try them out on yourself first. Most animals are as sensitive to pain as ourselves.

When treating wounds in any animal, provision should always be made for good drainage, as pus formation nearly always occurs. There should be an opening at the lowest part of the wound.

INFECTIOUS DISEASES OF HORSES

Equine Encephalomyelitis.—All outbreaks can be prevented by vaccination as the vaccine is almost 100% effective and the cost is moderate. The responsibility for the prevention of this disease rests squarely on the shoulders of the horse owner. The Animal Diseases Research Laboratory at the University produces and sells the vaccine. The fact that equine encephalomyelitis is communicable to humans is an added reason why it should be stamped out in horses. Several hundred cases have occurred in Saskatchewan during recent years in humans.

Two doses of encephalomyelitis vaccine, seven to ten days apart, given hypodermically, will definitely protect a horse for a year. The vaccination against this disease should be done each year in the spring. As there were only a few cases in recent years, horse owners have been inclined to neglect yearly vaccination. This is an unwise policy, as there is no way of knowing when another serious outbreak may occur. The vaccine is cheap and effective. For **treatment** of the disease, anti-encephalomyelitis serum should be used. It must be given very early in the disease in large doses (250 c.c.) to be effective. Given later, it is of doubtful value.

Swamp Fever (Infectious Anemia).—This disease still occurs in the newer settlements of the North. Research work done at the Animal Diseases Laboratory at the University proves that the disease can be prevented by avoiding swampy pastures and watering places. If slough water has to be used, it should run through a pipe or conduit containing lime. There is no specific cure, though many remedies are used. Mosquitoes and biting flies can transmit the disease from a sick horse to a healthy one.

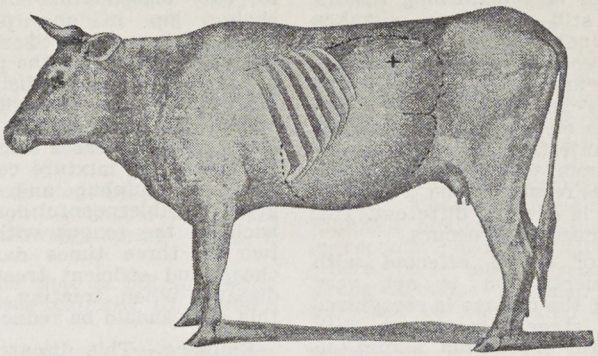
Influenza, Pink-eye, Pneumonia, Shipping Fever, which are allied diseases have been rare. If outbreaks should occur vaccination of contact horses should be done and affected animals treated with anti-serum. These diseases spread very rapidly. Isolation and thorough disinfection should be carried out. A bacterin for vaccination against this group of influenza-like diseases can be purchased from the Veterinary Science Department, University of Saskatchewan, Saskatoon.

For further information on diseases of horses, including foaling and diseases of the foal, see bulletin "Some Common Diseases of Horses and Cattle in Saskatchewan." This bulletin can be obtained from the Extension Department, University of Saskatchewan, Saskatoon.

CATTLE

NON-INFECTIOUS DISEASES

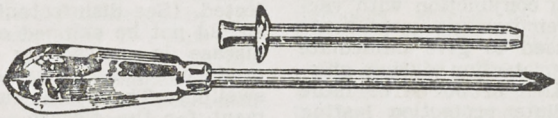
Bloating.—A distention of the first stomach or paunch with gas is a common digestive disturbance in the ox and may occur following sudden changes in feed, particularly from dry feed to lush



+ indicates the approximate place for "tapping."

green pasture. Overfeeding grain and the use of frozen feeds are other common causes. A marked distention of the abdomen, particularly on the left side, accompanied by uneasiness and difficult breathing are the symptoms usually observed.

Treatment consists of giving antiferments such as turpentine, four tablespoonfuls in a quart of water or milk, or a tablespoonful of creolin can be given in the same manner. Either of these treatments may be repeated every two hours if necessary. One to two quarts of mineral oil or ordinary motor lubricating oil is a useful treatment where other remedies are not available. Where the distention is severe and there is danger of suffocation, the animal should be tapped with a trocar and cannula on the left flank (see illustration). This will frequently give prompt relief and you are well advised to leave the cannula in the side until the gas stops forming. Care should be taken to disinfect the skin and sterilize the instrument before carrying out this operation.



A trocar and cannula—the proper instrument with which "tapping" should be done.

Impaction of the Rumen.—Overloading of the first stomach occurs frequently in cattle and can usually be traced to long continued feeding of dry feeds and the lack of water. Overfeeding of grain or chop may also be the cause. Lack of appetite, uneasiness, grunting, and failure to chew the cud, accompanied by constipation and fullness in the left flank are the common symptoms.

Treatment consists of complete starvation, which should be continued until the animal is observed chewing its cud. Encourage the consumption of water by giving small doses of common salt. Also give two teaspoonfuls of powdered nux vomica three or four times daily. Give two quarts of mineral oil the first day and follow with a pint twice daily until improvement is noticed. If bloating occurs, give two tablespoonfuls of turpentine with the oil.

INFECTIOUS DISEASES OF CATTLE

Hemorrhagic Septicemia is caused by a specific organism and should be handled by isolation of affected animals and vaccination of the rest of the herd with Hemorrhagic Septicemia Bacterin or Bovine Mixed Bacterin, Formula No. 1, and the premises thoroughly cleaned and disinfected. Many other domestic and wild animals, also poultry, are subject to the disease. This disease may be divided into four types, with symptoms corresponding to the organs affected. (1) Pulmonary (lungs and air passages) (2) Intestinal (which is rare) (3) Cerebro-spinal (brain and spinal cord) (4) Cutaneous (skin and adjacent tissues). The symptoms are not always as clear cut as this division would indicate, but often show more than one of the types. This point is of practical importance as the mixture of symptoms can be very

misleading with very disturbing results. Coccidiosis is still sometimes mistaken for the intestinal type of the disease. They are two entirely different diseases and until the animal parasite causing coccidiosis was discovered in the Province, most cases of coccidiosis were diagnosed as the intestinal form of hemorrhagic septicemia or dysentery, sometimes with fatal results as the treatment for coccidiosis is entirely different. This mistaken diagnosis still occurs.

Treatment of cattle affected with hemorrhagic septicemia is not very satisfactory. If the disease is recognized in the early stages, treatment with anti-hemorrhagic septicemia serum, in large doses, will sometimes stop the disease. One of the sulpha group of drugs is worth a trial.

Hemorrhagic Septicemia under the Name of Shipping Fever has become a serious problem to shippers of cattle. When shipping fever is prevalent, cattle should be vaccinated with two doses of Hemorrhagic Septicemia Bacterin or Bovine Mixed Bacterin, Formula No. 1, five to seven days apart, the last dose to be given at least ten days before shipment. Where this is not feasible, one dose given fourteen days before loading will give some protection. Losses from this disease can be reduced by avoiding undue exposure and excitement during transit, in conjunction with vaccination. Anti-hemorrhagic septicemia serum can be used to give immediate and short-term protection during shipping. One injection of 50 cc or more will give immediate protection lasting from fourteen to twenty-one days. The total picture of shipping fever in cattle is not yet clear. Vaccination, using either the bacterin or the anti-serum has failed to protect in some cases. The reasons cannot be discussed here. The foregoing is the best that can be offered up to the present.

Coccidiosis is caused by a protozoan or animal parasite and affects mostly the linings of the small colon and rectum, destroying them in patches, leaving raw, bleeding surfaces. The animal stands with arched back, strains a lot and passes loose, bloody stools and pure blood, loses flesh rapidly and sometimes goes into convulsions. In dealing with the disease, it is best to send scrapings from the wall of the rectum to the Animal Diseases Laboratory at the University to confirm the diagnosis. They should be sent in a clean, small glass or other container. The treatment consists of giving one to two teaspoonfuls of thymol well shaken up in one pint of warm water daily. Affected animals should be kept isolated and the place thoroughly cleaned up and disinfected before healthy animals are allowed in it. A bulletin on coccidiosis is available from the Animal Diseases Laboratory at the University. A mixture containing equal parts of sulphur and iron sulphate given in tablespoonful doses, placed well back on the tongue with a tablespoon two or three times daily is another cheap and efficient treatment for this disease. When treating small animals, this dose should be reduced by one half.

Blackleg.—This disease is fairly well known and occurs in most parts of the Province. Usually the first symptom noticed is that of finding one or more young cattle dead, showing crackling swellings on various parts of the body. If seen alive, the animal stays alone; shows great distress; breathing is quick and labored; temperature is high; there is lameness in some cases; the typical swellings appear, which crackle when pressed with the fingers. The animal goes down in a state of coma and dies usually in from twelve to forty-eight hours. Dead animals should be buried deeply along with their discharges and all contaminated material such as bedding, grass and soil. Things that cannot be buried should be thoroughly disinfected. (See disinfectants). The carcass should not be skinned or even cut. The disease is caused by a germ which produces gas, hence the crackling swellings. There is no satisfactory treatment for the disease.

Blackleg can be successfully prevented by vaccinating all young cattle under three years of age with a reliable blackleg bacterin. As animals over this age are rarely affected, it is not considered necessary to vaccinate the older animals in the herd. One injection of the bacterin will usually protect the animal for life but where calves are vaccinated when very young, it is advisable to revaccinate them when they are a year old.

Another disease known as malignant edema may be readily confused with blackleg as the symptoms are very similar. This disease may affect cattle of any age and where it is suspected to be causing losses, all the cattle in the herd should be vaccinated. As far as is known, malignant edema is not prevalent in this Province but should losses be occuring in young cattle that have been properly immunized for blackleg, the entire herd should be revac-

cinated with the Clostridium Chauvei Septicus Bacterin, which will protect cattle against both blackleg and malignant edema.

To summarize the important points in blackleg control:

1. Vaccinate all cattle under three years of age.

2. Calves vaccinated before weaning or while very young should be revaccinated the following spring when a year old.

3. Use vaccine that is not out-dated and has not been exposed to extreme heat or frozen.

4. Bury dead animals and all contaminated material in a grave six feet deep, covering the carcass with a layer of quicklime before filling in. This depth and the quicklime lessen the chances of dogs and coyotes getting at the carcass and spreading the germs around.

Bang's Disease, Brucellosis or Contagious Abortion in Cattle.—Bang's disease is probably the most serious infectious and contagious disease of cattle in Saskatchewan. It is characterized by an inflammation of the reproductive organs, which, in the female is frequently followed by an abortion. Contagious abortion is very widespread, both in Canada and the United States. From the testing of herds in Saskatchewan, the general incidence of the infection is approximately 7%. This disease results in abortions which are frequently followed by retained afterbirths, sterility, together with decreased production and as a consequence, is the cause of severe financial losses. Cattle of all ages are susceptible and man may become infected with this organism as the result of handling infected stock or consuming unpasteurized milk from infected animals. The disease in man is known as Undulant Fever.

The prevention and control of Bang's disease is very difficult as animals, once infected, remain carriers of the infection for life. The organism is shed in large numbers from the vagina following calving and also in the milk. Susceptible animals readily become infected by ingesting contaminated food and water or from contact with diseased animals. The only accurate method of diagnosis of this disease is by means of a blood test, and the Veterinary Division of the Saskatchewan Department of Agriculture sponsors a policy of Bang's testing which features the collection of blood samples at a very reduced fee and by paying for the testing of the blood sample at the Veterinary Laboratory.

The Department of Agriculture also sponsors a policy of supervised calfhood vaccination whereby Brucella abortus vaccine is supplied free of charge to veterinarians for the purpose of vaccinating calves four to eight months of age. Calfhood vaccination is the only method whereby animals can be immunized against this infection and it is recommended, particularly in areas where the infection already exists, that young females intended for breeding purposes be vaccinated in order that they develop an immunity against this organism.

In the control of Bang's disease the following is to be recommended:

(a) Bang's test all herd additions prior to allowing them to enter the herd.

(b) Do not allow negative cattle to graze with infected stock.

(c) Infected animals should be isolated and sold for slaughter, if possible, as they remain a constant source of infection in the herd.

(d) When an abortion occurs, isolate the cow that has aborted, bury the aborted foetus deeply, and burn all litter.

(e) All female calves four to eight months of age, intended for breeding purposes, should be vaccinated with Brucella abortus vaccine.

For further particulars and literature with reference to Bang's disease, Bang's testing or calfhood vaccination, write the Provincial Veterinarian, Department of Agriculture, Regina, or the Animal Diseases Laboratory, University of Saskatchewan, Saskatoon.

Mastitis.—Mastitis, or garget, may be defined as an acute or chronic inflammation of the udder, usually associated with the destruction of udder tissue and the partial or complete loss of function of the gland. The production of cows suffering from this disease is not only greatly reduced but the milk is of poor quality and contains bacteria and pus which might endanger human health if consumed in its raw state. Where it is suspected that cows are suffering from this disease, it is advisable to submit milk samples to the Animal Diseases Laboratory, University of Saskatchewan, Saskatoon, for a bacteriological examination to determine if it is fit for human consumption. A similar service is also available from the Public Health Laboratory, Legislative Build-

ings, Regina. While some forms of mastitis may be non-infectious, in most instances it is considered as an infectious disease and readily transmitted from cow to cow by the hands of the milker, milking machines and other mechanical means. The practise of good sanitation in the milking routine is, therefore, one of the first essentials in the control of this disease.

Various types of bacteria are capable of producing mastitis and usually enter the udder through the opening in the teat or through wounds or abrasions in the skin of the teats or udder. To reduce the incidence of the disease, it is, therefore, important to protect the udder from injuries and the use of milking tubes should be discouraged as they are a common means of introducing infection into the udder of a cow.

Two types of mastitis should be recognized, the acute and chronic. In the acute form, the symptoms develop rapidly, are readily visible, and one or more quarters of the udder may be destroyed in the course of a few days. In the chronic form, the progress of the disease is slow and it may require several months for visible symptoms to develop, the passing of a few clots and curds in the milk with the gradual hardening of the quarter being the changes usually observed. Dairymen should be continually on the look-out for the chronic form of this disease.

Acute mastitis has always proved difficult to treat successfully as the course of the disease is rapid and irreparable damage is often done to the udder before treatment can be adopted. Frequent milking or the stripping out of the infected quarters every two hours, hot fomentations to the udder, followed by the application of a white liniment are to be recommended. Sulphanilamide is a drug which has proved helpful in reducing the severity of acute cases and should be given by mouth in half ounce doses four times daily and continued for three days. Udder infusions have not proved very successful in the treatment of acute cases.

The treatment of chronic mastitis has proved successful if adopted in the early stages. The injection directly into the udder of specially prepared solutions known as udder infusions being the type of treatment recommended. Such infusions can be used both on lactating and dry cows. As these injections must be made under aseptic conditions and with sterile instruments, it is suggested that for further information regarding them, you consult a veterinarian. Penicillin, forty thousand units dissolved in 100 cc of sterile distilled water and infused into each infected quarter after it has been stripped dry has proved effective for this purpose, these treatments being repeated as required. Penicillin bougies, or small sticks of solid penicillin, which can be inserted directly into the opening in the end of the teat are now available and can be used instead of the solution in the treatment of this disease.

Ringworm.—An infectious disease of the skin caused by a fungus (trichophyton tonsurans). The fungus attacks the roots of the hairs and the upper layers of the skin, causing a typical lesion. Young cattle are mostly affected but some older animals are susceptible. It affects other animals and man as well. The disease is spread by contact with affected cattle, contaminated objects, or by man, cats and mice in some cases.

The symptoms appear as raised, scaly, greyish crusts, with broken hairs protruding. The crusts are roundish in shape and mildly itchy. Ringworm is found most often on the head, around the eyes, and on the neck and shoulders but can appear on any part of the skin. It is more common in the fall and winter amongst young cattle that are crowded together in dark, dirty stables, but can occur under ideal conditions.

Treatment is usually successful, though more than one remedy has sometimes to be used. It is a good plan to apply vaseline to the crust; scrape it and the crust off the next day, and paint the part with tincture of iodine daily afterwards. The following remedies are also useful: sulphur ointment, nitrate of mercury ointment, iodide ointment, applied once a day.

To prevent it spreading, affected animals should be isolated, and all contaminated litter, etc., burned and the premises thoroughly disinfected. (See disinfectants). Thoroughly scrub the hands with hot water and soap after handling an affected animal.

Warble Flies.—It is generally conceded that the annual losses caused by this fly are tremendous and such as to warrant that control measures receive more attention. The continual annoyance caused by warble flies results in reduced milk production, less thrifty calves, and loss of weight in cattle generally. Hides are reduced in value due to the presence of grub holes

and scar tissue. The trimming required along the back of grub infested slaughter cattle also results in great loss of valuable beef annually. The annual treatment of cattle for the control of warbles is recommended to reduce these losses.

Black Flies.—During the latter part of May or early June, large flights of black flies emerge from the Saskatchewan river and according to the prevailing wind, may be carried for many miles in any direction. Exposure of cattle, horses, or sheep to heavy flights of these flies is frequently followed by severe losses indicated by sudden deaths. When attacked by black flies, cattle show evidence of uneasiness and seek shelter. If carefully examined, the small black fly with greyish wings will be found in large numbers clinging to the lower surface of the neck, abdomen, and other lightly-haired parts of the body. When severely bitten, an edematous swelling of the skin may be found about the throat, neck and lower abdomen. These symptoms are frequently followed by sudden deaths within twelve hours of the attack. Animals which live for a longer period usually recover within a few days. Cattle pastured within a reasonable distance of the Saskatchewan river should be watched closely during the black fly season and given protection by stabling or smudges when attacked by these flies. The use of fly sprays and repellents are advocated but their value is questionable unless applied very frequently. For further information on warble and black fly control, see section on insect pests of livestock.

SWINE

Infectious Diseases of Swine.—With regard to making a diagnosis of diseases of swine, it has been found after extensive experience, that it is rarely possible to make an accurate diagnosis from clinical symptoms in the hog lot. Post-mortem examination with scientific laboratory aids is necessary to establish a diagnosis. All successful disease control is based on accurate diagnosis.

Swine Plague. (Hemorrhagic Septicemia).—This disease takes a heavy toll from the profits of swine breeders. It should not be confused with hog cholera. Diagnosis is not easy. In suspected cases, owners are advised to send a live sick pig to the Animal Diseases Laboratory at the University, express prepaid, where a careful scientific effort is made to identify the germ causing this disease.

The symptoms are too varied to attempt a full description here, but in most cases there are signs of respiratory trouble, difficult breathing, coughing, a discharge from the nose and eyes, debility, loss of flesh and in some cases, nervous symptoms and diarrhoea.

Vaccination of healthy hogs, isolation and thorough cleaning and disinfection are the best measures to adopt in controlling an outbreak. Swine plague bacterin for vaccinating against this disease can be obtained from the Veterinary Science Department, University of Saskatchewan. Treatment of swine plague is not very satisfactory as yet.

Swine Erysipelas.—Many hogs in the Province are affected with this disease in the chronic form, often not recognized. Hogs that are not making gains, show a thick, scaly skin, or a skin showing patches with a purple border and sometimes swollen, painful joints should make their owner suspicious of swine erysipelas. Any group of hogs showing the symptoms mentioned should be isolated. There is an acute form also. A sick hog should be sent to the Animal Diseases Laboratory for diagnosis; if the diagnosis is confirmed instructions will be sent to the owner. Human beings are susceptible to the disease but it is not the same disease as human erysipelas. If given very early in the disease, in large doses, anti-swine erysipelas serum is of considerable value in treatment, especially in the acute form. It also gives very good results used for prevention in healthy pigs that are liable to be exposed to the disease. Anti-swine erysipelas serum can be bought from the Animal Diseases Laboratory at the University.

Swine Influenza (Hog 'Flu).—This disease is present in Saskatchewan and in some years reaches the proportions of an epidemic. The mortality is not great, but the loss of flesh is severe and often makes the difference between profit and loss. The symptoms are those of

respiratory trouble, difficult breathing, coughing, high temperature, and a very profound depression with rapid loss of flesh. No medicine, vaccine, or antiserum has proved of any value, as a treatment or preventive. Best results are obtained by putting the sick animals in clean, warm, dry, well ventilated quarters. When this is done, deaths are reduced and the period of illness shortened, and the severe loss of flesh much less.

Rhinitis (Bullnose) is a disease of swine indicated by chronic sneezing, bleeding from the nostrils, shortening of the upper jaw, and occasionally a marked twisting of the snout, these symptoms being accompanied by unthriftiness and slow growth. Affected hogs usually require from eight to ten months to reach market weight.

While the exact cause of this disease is still unknown, it is considered to be infectious and is usually introduced by the purchase of new animals which may exhibit few if any symptoms of rhinitis. Nursing pigs are particularly susceptible while older animals are much more resistant. As there is no treatment or vaccine which appears to be of value control measures consist in adopting certain approved sanitary practices.

In controlling this disease, therefore, it is advisable to consider all the young animals on the premises as infected and dispose of them for slaughter as soon as they reach market weight. Keep only the mature sows for breeding purposes. Farrow all litters on clean ground and maintain them entirely apart from all other hogs until they are past the weanling stage when they will be much more resistant to this infection. To avoid introducing this disease, purchase swine only from herds free from rhinitis and a careful inspection of all the swine on the vendor's premises is advisable before buying new pigs.

NON-INFECTIOUS DISEASES OF SWINE

Anemia.—This condition causes severe losses in Saskatchewan, not only from the disease itself, but also from the weakened condition of the piglet, making it more susceptible to the prevailing infectious diseases. It is caused by a shortage of iron in the milk of the sow. The symptoms, which appear when the piglet is a few weeks old, are fatigue, shivering, quick breathing, dullness, thumps; at this stage the body appears round and plump, but the skin is pale and bloodless looking. If the animal lives, it becomes thin and unthrifty, and may develop scours or pneumonia. Treatment consists in giving some form of iron. The following has given good results, both for treatment and prevention.

Treatment: Ferrous sulphate drachms five, add sufficient water to make eight ounces. Give one teaspoonful in a little water daily, for four or five days until the piglet improves. Then two or three times a week until weaning time, if needed.

Prevention: Starting when pigs are four days old, a pinch of reduced iron or iron sulphate, as much as can be held on a dime, should be placed well back in the mouth of each pig every week or on the fourth, eleventh, and seventeenth days after birth. This will usually carry pigs through to weaning age. Another method is to place a piece of turf or black soil in the pen daily so that pigs can get iron by eating the earth and grass roots. Sprinkling the sod with a solution containing a tablespoonful of iron sulphate to a quart of water makes it better for this purpose. As soon as pigs are weaned and eating solid food the danger of anemia is past.

Feeding and Sanitation.—The prevalence of deficiency diseases would indicate the necessity of drawing the attention of swine producers to the importance of balanced diets in keeping swine healthy. The ingredients most commonly lacking in swine rations are proteins, minerals, and vitamins. Protein deficiencies are indicated by unthriftiness, rough skin, slow growth, and certain forms of scours; calcium and vitamin D deficiencies by convulsions and rickets in growing pigs and paralysis in nursing sows; iodine deficiencies by the birth of hairless pigs suffering from goitre; vitamin A deficiencies by sterility in sows and the birth of weak litters lacking in vitality. To prevent such conditions, proteins can be supplied by feeding milk, tankage, or a protein mineral supplement. Calcium can be given by the addition of ground limestone, one percent to the grain ration of growing pigs and brood sows. An iodine supplement can be prepared by dissolving one ounce of potassium iodide in one gallon of soft water. Give pregnant sows a tablespoonful of this solution in the feed twice a week. The best sources of vitamin D are exposure to direct sunlight and fish liver oil. Vitamin A can

be supplied by the use of green feeds and fish liver oil. Small quantities of fish liver oil should be fed to all growing pigs and brood sows during the winter months.

By keeping swine under sanitary conditions, the prevalence of worms and other parasites can be greatly reduced and losses from infectious diseases very much curtailed.

DISEASES OF SHEEP

It is often difficult to correctly diagnose diseases in sheep and the aid of a laboratory frequently is necessary. When possible, a sick sheep should be sent to the Animal Diseases Laboratory at the University for this purpose, express prepaid. Do not send a dead sheep.

Contagious Ecthyma.—This condition is commonly known as sore mouth or lip and leg ulceration. It is caused by a filterable virus and is infectious to man also. The symptoms are, ulcers around the lips and sometimes on the feet. The ulcers develop thick, dark, rough scabs. Underneath the scabs there is a layer of soft, dark red, proud flesh. Affected sheep should be isolated and the sores treated daily with a 2% solution of permanganate of potash made with boiled or distilled water. The pens, etc., should be disinfected and all scabs burned. Recovered animals are usually immune to another attack. Sheep can be successfully vaccinated against the disease. Contagious ecthyma is rarely fatal but the loss of condition, especially in feeder lambs for market is serious. Since attention was drawn to this disease in the 1945 "Guide," several large outbreaks have been recognized in the sheep country of the South, and the University has been called upon to make a vaccine. Some vaccine has been made and sent out but if sheep men wish a constant supply to be on hand, they will have to collect the scabs from affected sheep and forward them to the Animal Diseases Laboratory, University of Saskatchewan, Saskatoon, as the supply at present is exhausted. The vaccine is made from the scabs. They should be handled with a spoon or forceps, and not with the bare hands as the disease is communicable to humans.

Pregnancy Disease is a fairly common disease of pregnant ewes and research has proved it to be a problem of feed and management. It is usually found in a flock that has wintered badly, though it does occur occasionally in ewes that are fat. It has been proved that 80% of the animals that developed the disease were carrying twins or triplets. The symptoms usually appear during the last month before lambing and are indicated by weakness, grinding the teeth, uncertain gait, difficulty in getting up and towards the end, paralysis and coma. The treatment, to be effective, must be given early before pronounced symptoms have developed and consists of giving dextrose or some other form of sugar, molasses or syrup as a drench, four to six ounces in a quart of water four times a day. Treatment is more effective if the dextrose or glucose is given hypodermically or directly into the blood stream but this requires the services of a qualified veterinary surgeon. Ewes that lamb during the course of the disease usually recover. Prevention consists in supplying pregnant ewes with a well balanced diet and moderate exercise. Working on the assumption that a lack of vitamin A may be the cause, care should be taken to supply a ration rich in this vitamin. This can be done by feeding a good green roughage such as alfalfa, clover, tame or wild hay, the one essential being that the roughage be green and of good quality. Any roughage that has become discolored during the curing process is of little value in this respect. Where no green feeds are available, a good grade of fish liver oil, at least a teaspoonful for each ewe should be fed daily. A reasonable amount of grain should also be supplied during the latter part of the pregnancy period.

POULTRY DISEASES

Avian Tuberculosis is a chonic infectious disease of poultry that is very prevalent in both chickens and turkeys in this Province. Swine are also susceptible but other farm animals and humans are not affected with this type of tuberculosis. The organism causing this disease is eliminated in the droppings of infected birds, and healthy fowl which come in contact with this infected material soon contract the disease.

As tuberculosis develops slowly, symptoms are rarely seen in birds under a year old and consist of unthriftiness, lack of vigor, and loss of weight, the birds dying in an emaciated condition after a period of time. If a dead bird is opened small, greyish white nodules varying in size from a pin head to a pea will be found throughout the substance of the liver. Similar lesions may also be found in the spleen and along the course of the intestine in advanced cases.

As there is no treatment for tuberculosis, control measures consist of destroying all unthrifty birds, the carcasses of which should be burned. Fowls which appear to be healthy can be kept until the end of the laying season and then the entire flock marketed. The poultry houses should then be thoroughly cleaned and disinfected and left vacant for a few weeks before bringing in new stock. The new birds should be kept closely confined in the clean houses to prevent the possibility of infection from contact with contaminated outside yards and runways. Where chicks are being raised on such premises, they should be kept on clean ground entirely apart from the adult flock. It is well not to keep any birds over eighteen months old on the premises for a few years. As a general rule, the carcasses of birds which appear to be thrifty and show only a few nodules in the liver can be used for human consumption provided the flesh is well cooked before being consumed.

Caecal Coccidiosis is an acute, infectious disease of chickens caused by minute animal parasites known as coccidia. While fowl of any age are susceptible, older birds are usually immune, from previous exposure, and the disease is seen most commonly in chicks from six to twelve weeks of age. As warm moist conditions favor the development of this parasite, outbreaks are more common during the months of May and June. From one to two weeks after chicks which have been brooded under good conditions are turned out on old poultry runs, they will show symptoms of sleepiness, loss of appetite, and lack of vigor. They may also suffer from diarrhoea. About this time, blood will be noticed in the droppings and during the next forty-eight hours, from twenty-five to forty per cent of the chicks may die. Few losses will be sustained after this period and the surviving birds will gradually recover. If a dead bird is opened, the caeca (two blind pouches attached to the intestine) will be inflamed and enlarged and contain a hard core of bloody material.

Prevention lies in keeping young chicks on clean, dry ground which has not been previously run over by adult poultry. During the past year, the use of certain sulpha drugs has proved very successful in the treatment of this disease but to be effective, treatment must be applied when the first sign of blood is noticed in the droppings. This treatment consists of using one ounce of either sodium sulphamethazine or sodium sulphamerazine in each three gallons of drinking water giving this medicated drinking water for a period of three days, then ordinary drinking water for four or five days and, if there is any sign of a relapse, continue the treatment for two more days. Sulphamethazine and sulphamerazine are insoluble forms of the same drug and, while they cannot be used in the drinking water, can be mixed in the proportion of one ounce in each fifteen pounds of mash and fed to the birds in exactly the same way as when using the soluble forms of these drugs in the drinking water. Birds recovering from an attack of coccidiosis are, as a rule, permanently immune to this disease.

DISINFECTANTS

Disinfectants for Wounds.—The following antiseptics are useful and safe for wounds:

Cresol, creolin, lysol or carbolic acid in a 2% solution.
Tincture of iodine, 2½% strength.
Mercurochrome, 1% to 2% solution.

As a dry dressing antiseptic, a dusting powder composed of boric acid, seven parts, iodoform, one part, is useful or the wounds may be dusted with sulphanilamide.

Washing the wound with a normal saline solution (a heaping teaspoonful of pure salt to a quart of boiled, warm water) is a cheap and reliable practice.

During the fly season, it is important that flies be kept away from wounds. For this purpose, oil of citronella applied around and over the wound twice a day will keep them away. Commercial fly repellants put up by a licensed firm with a license number on the package are reliable.

It is a good practice in making antiseptic solutions to boil the water that is used.

METHOD OF DISINFECTING STABLES AND HEN HOUSES

1. Remove manure completely from the floor and walls by a thorough scraping.

2. Sweep carefully all corners, crevices and positions where dust may collect around sills, plates, and roof timbers, and remove dust screenings, cobwebs, and other refuse.

3. Sweep out thoroughly mangers, feed racks, troughs, runways and passages, and scrub thoroughly with hot water and lye, using one can of lye in fifteen to twenty gallons of hot water.

4. Burn all scrapings and sweepings.

5. Empty and scrub individual drinking bowls or drinking troughs with a reliable disinfectant solution.

6. Apply a heavy, even coating of limewash, containing a reliable disinfectant, to the floors, walls, partitions, mangers, feed racks, and gutters.

7. In making limewash, use one pound of lime in a gallon of water and as disinfectants vary greatly in strength, they should be used according to directions on the container.

8. Remove all manure, straw, bedding, and other refuse from the neighborhood of the building.

9. As it is impossible to cleanse and disinfect an earth floor, it is suggested that the top six inches of soil be removed and replaced with six inches of fresh soil from a clean source.

10. Outside yards and runways which have been occupied by diseased poultry cannot be rendered safe by disinfection and should be left vacant for at least a year. All litter and manure should be removed so that the surface of the soil will be exposed to direct sunlight, and light surface cultivation is also advised. Healthy birds should not be placed in such yards for at least a year after the diseased fowl have been removed.

Sulpha Drugs.—Various sulpha drugs are now used extensively in the treatment of animal diseases with sulphanilamide being the preparation used most frequently for this purpose. These drugs can be administered by mouth in the following dosage: one grain per pound of body weight divided into four equal doses daily and continued for three days. If continued for a longer period, the dose should be reduced by one half.

COMMON HOUSEHOLD UTENSILS FOR MEASURING

1 teaspoonful=1 drachm=⅛ ounce.
1 dessertspoonful=2 drachms=¼ ounce.
1 tablesponful=4 drachms=½ ounce.
1 wineglassful=2 ounces.
1 waterglassful=8 to 10 ounces.
1 teacupful=5 to 7 ounces.

Household utensils vary a lot in size. The above table represents the smaller sizes.

APOTHECARIES' WEIGHTS

1 grain
1 scruple=20 grains.
1 drachm=3 scruples=60 grains.
1 ounce=8 drachms=480 grains.
1 pound=12 ounces=5760 grains.

LIQUID MEASURE

1 minum (drop).
1 fluid drachm=60 minums.
1 fluid ounce=8 fluid drachms.
1 pint=20 fluid ounces.
1 quart=2 pints.
1 gallon=4 quarts.

TABLE FOR MAKING PERCENTAGE SOLUTIONS

The amounts are only approximate, but exact enough for practical purposes.

1 dessertspoonful in 1 pint=1%=1 part to 100 parts.
1 tablespoonful in 1 pint=2½%=1 part to 40 parts.
2 tablespoonfuls in 1 pint=5%=1 part to 20 parts.
4 tablespoonfuls in 1 pint=10%=1 part to 10 parts.

SERVICES AVAILABLE

HEALTH OF ANIMALS DIVISION, DOMINION DEPARTMENT OF AGRICULTURE, OTTAWA

Saskatchewan Offices:

Post Office Building, Regina
Federal Building, Saskatoon
Post Office Building, Moose Jaw
Post Office Building, Weyburn
Provincial Highways Building, Yorkton

The Health of Animals Division is responsible for the enforcement of the Animal Contagious Diseases Act, the Meat and Canned Foods Act and the regulations and orders made under these Acts.

Contagious Diseases.—Outbreaks or suspected cases of diseases such as mange in horses and cattle, sheep scab, hog cholera, glanders, etc., are investigated and dealt with under the Contagious Diseases Act.

Bovine Tuberculosis.—This disease is dealt with under three main policies; viz, "Accredited Herd Plan," "Restricted Area Plan" and Supervised Herd Plan." The Accredited Herd Plan is for the assistance of purebred breeders. The Restricted Area Plan is the policy under which all cattle within a rural municipality, or group of municipalities, are tested. The Supervised Herd Plan is for the assistance of the farmer with an ordinary grade herd.

Bang's Disease (Contagious Abortion)—A limited amount of assistance in controlling and eradicating this disease is available to herd owners in a position to comply with the terms of an agreement under which the service is offered.

Inspection Service.—Any necessary testing and inspection of all classes of live stock is made of shipments intended for export to foreign countries and, where required, inter-provincial consignments.

The Meat and Canned Foods Act.—A meat inspection service is offered under this Act. Seven packing plants in Saskatchewan are already under inspection.

VETERINARY DIVISION, PROVINCIAL DEPARTMENT OF AGRICULTURE, REGINA

1. Investigates outbreaks of animal and poultry diseases where requested by veterinarians or by farmers where veterinary service is not available.

2. Supervises the Provincial plan of Supervised Calfhood Vaccination for the control of Contagious Abortion (Bang's Disease) and administers the provincial Bang's Disease Test Agreement for the testing of cattle for Contagious Abortion.

3. Assists in the collection of blood samples from herds under the provincial Bang's Disease Test Agreement in areas not served by a veterinarian.

4. Assists in the vaccination of calves with Brucella abortus vaccine in areas not served by a veterinarian.

5. Pays, under certain conditions, laboratory fees for the testing of cattle for Bang's Disease (Contagious Abortion).

6. Co-operating with the University of Saskatchewan, supplies Brucella abortus vaccine for calfhood vaccination and also pays the cost of blood testing associated with the supervised plan of calfhood vaccination.

7. Answers correspondence relating to diseases of animals.

8. Co-operates with the Veterinary Director General in the distribution of live culture vaccines for the control of certain diseases such as fowl pox and laryngotracheitis.

9. Supervises the organization and control of Veterinary Service Districts under the Veterinary Services Act.

VETERINARY LABORATORY, UNIVERSITY OF SASKATCHEWAN, SASKATOON

The services rendered at the Veterinary Laboratory, University of Saskatchewan, include the diagnosis of infectious diseases through the examination of suitable specimens such as:

1. Blood samples and organs from animals which have died from bacterial infections.

2. The examination of milk samples for the recognition of udder diseases and to determine if the milk is fit for human consumption.

3. The recognition of parasites, internal and external.

4. The testing of blood samples for contagious abortion of cattle.

5. Post mortems on pigs, sheep and poultry to determine the nature of the disease from which they may have been suffering.

6. The production and sale of bacterins for equine distemper and influenza, autogenous bacterins for garget in cattle, swine plague bacterin, anti-swine erysipelas serum.

7. The production and sale of equine encephalomyelitis vaccine and antiserum.

8. Making and issuing to authorized persons, the vaccine for calfhood vaccination in contagious abortion.

FARM MANAGEMENT

BUSINESS PRACTICES IN FARMING

The day-to-day business decisions required in farming are so variable that they prohibit summary except in terms of the individual circumstances involved. A number of more general business practices, however, which are important in determining the long-run financial success of farming, may be briefly outlined as follows:

1. Obtaining a Good Size of Business

A larger-sized farm business gives fuller employment of the operator's and family labour. It also reduces costs, particularly for the main overhead items such as buildings, equipment and family living. Hence, a larger farm business usually allows a higher level of family living and a greater margin of savings than a small farm. Realizing good financial progress in farming therefore depends upon gradually building up the farm to efficient size.

A good size of farm is one large enough to fully occupy the family labour when working with efficient power and equipment. A fully efficient size of farm will usually be considerably larger than a good family-sized unit. In the prairie region, where grain growing and power farming are adapted, at least 800 to 1000 acres of average cropland are necessary for good family size for an operator with an additional family worker. In the parkland region, where yields are higher, more cultivation is required, and more livestock is kept, 450 to 600 acres of cropland with the average amount of livestock are needed for reasonably good family size. Where topography is unfavourable, where horse power is used, or where more livestock is handled, somewhat smaller acreages would apply. For poorer soil areas, on the other hand, larger acreages than above are necessary to give a good family-sized unit.

Building up the farm to better size should be based on a long-range plan which considers the best method of expansion, and which will provide for expansion when the costs of land and other capital items are low. Some farms allow desirable expansion by building up special crop or livestock enterprises without a large addition to the land area. Such method should consider the long-run opportunity for returns and the ability to reach a good final size. Disappointments have occurred when expansions of this kind did not give the best returns or failed to allow an efficient final size of business.

For the majority of farms, and particularly in the first stages of expansion, the best opportunity for increasing size will be given by adding to the area of cropland handled. In such process, renting additional land is often a good alternative to purchasing, particularly when capital is limited. Expanding by purchase requires careful decisions as to the time of purchase, size of purchase, the price paid, and the method of payment, to assure safety and a low cost of the investment. Timing purchases for low-value periods, and making limited additions on the basis of a satisfactory down payment and a safe debt ratio, have proven to be necessary requirements in terms of past experience.

Because of the narrow margin of savings allowed by a small farm, care is needed to avoid a starting size of farm which may be too small. Overcoming such small size will often require temporary sources of income such as custom work, off-the-farm labour, or special enterprises to obtain sufficient capital for expansion.

Expanding the farm beyond good family size will usually depend on greater than average managerial ability. Poor management may quickly offset the gains which would otherwise be allowed by large size. The point of best size will usually be over-reached when inability to manage timely operation and good production practices begins to result in lowered yields.

2. Using Better Production Practices For Good Yields

Within moderate limits, higher yields of crops and livestock usually result in higher net returns, as the income added is normally greater than the costs involved. This gives a favourable opportunity on most farms for improving returns by the use of better production practices. However, because of necessary costs, there are upper limits beyond which higher yields will no longer add to net returns. Hence, there is need for careful selection of yield-improving practices which will be eco-

nomically practicable in terms of their returns and costs.

The main factors which determine how far particular practices may be carried are (a) the price of the product (b) the costs of the materials, labour and equipment used and (c) the amount of yield response given by the land or animals concerned. Differences in these factors result in large differences in the economy of specific practices. Hence, adapted yield-improving practices often are not carried far enough when product prices are high and costs low, and are sometimes carried too far under the opposite conditions. Similarly, good production is often not carried far enough with good land and good animals, and at times is carried too far with land and animals which are basically too poor to respond.

Building up better production practices should be guided by a thorough appraisal of the yields being obtained and the apparent weaknesses of present practices. On the basis of such inquiry, first attention should then be given to practices which will overcome the most serious limitations to better yields. Effective practices which are low-cost, in the sense of involving little or no direct outlay, such as more timely operation and better tillage, will also warrant adoption at an early stage. Further effective practices, in turn, should each be carefully assessed for their possible benefit to returns, recognizing their varying economy under different price, cost and yield conditions.

As a general rule, the farmer can aim at yields considerably above the average for his soil type and district with reasonable assurance that they will give increased net returns. In general, too, the most profitable yields will usually be obtained most readily on the basis of good land and good animals.

In crop production in Saskatchewan, lack of sufficient moisture continues to be the main factor limiting yields. Hence practices which provide more efficient use of moisture are the most important ones allowing an improvement of returns through better yields.

Selection of the most effective amount of summerfallow for moisture conservation and weed control; use of favorable crops and rotations; effective weed control measures; timely seeding and summerfallowing, and securing good tillage, are important practices in this category.

Additional practices involve building up necessary fertility through fertilizers and rotations, using adapted varieties and good seed, controlling erosion, and guarding against the various crop losses. In each case, consideration should be given to the different yield responses allowed by particular practices under different soil and climatic conditions.

In livestock production, breeding and selection to obtain a reasonably good grade of animal is a first consideration in economic production practice. Good feeding, recognizing a low cost of basic ration, the essential needs for maintaining health and vigor, and the particular requirements in production, is essential. In turn, provision of adequate and convenient housing at low cost, and good general care to guard against production losses, are necessary elements of good animal production practice.

3. Building Up An Effective Combination of Enterprises

Because of their ability to fit together, a well-selected group of enterprises usually allow higher and more stable returns than a single type of production. If production of a single commodity can be carried to its best size and specialization it provides a satisfactory farm organization. For the majority of farms, however, a main enterprise balanced with one or more secondary enterprises making full use of the facilities of the farm will usually assure higher and more uniform returns over an extended period.

The main considerations in good enterprise combination are (a) obtaining fullest possible use of labor, (b) a cropping system giving the best output of cropland, (c) effective use of wasteland and by-products, and (d) offsetting major risks and obtaining a good income distribution. In general this implies that the farm should be organized to support the largest possible major enterprise, in the form of the crop or livestock enterprise allowing the highest returns for the use of land and labor. Further enterprises should then be added which will effectively round out the land and labor use, without too serious interference with the main production.

A more complete rounding out of land and labor use, and greater insurance against yield and price risks, will usually be obtained within a combination of both crop and livestock enterprises. Incorporation of livestock enterprises in this regard depends upon reasonably low-cost feed supplies. Where yields of feed grains and forage warrant their use in the rotation, addition of livestock enterprises to use a maximum of such feeds will usually be successful. On the

other hand, livestock will not be readily adapted if their feed must be produced at serious disadvantage in comparison with the main cash crop. Hence, for grain-consuming animals such as hogs and poultry, ability to produce feed grains cheaply on the basis of favorable yields and benefits in the rotation is usually essential. For forage-consuming animals, such as cattle and sheep, presence of a fair amount of wasteland pasture and wasteland or by-product roughages will usually be necessary. Such enterprises will not normally be profitable when a large proportion of their forage needs has to be met from cropland. Exceptions occur where the yields of cultivated forage are high, when forage is a by-product of cash-crop production or when high-return production such as fluid milk production is allowed. Also, when forage crops can combine to give essential erosion control or conservation, the use of cultivated forage to supplement available wasteland production may be beneficial to both land use and the economy of livestock.

While the farm business should support sufficient of each of the various enterprises which meet home needs, the building up of effective income-producing enterprises should rely on the one or two enterprises which are best adapted to the farm. The common attempt to diversify with a large number of enterprises usually results in too small enterprises, with low labor economy and ineffective returns. One or two well-developed enterprises in their place will usually provide more efficient labor use and encourage better production practices giving better returns.

The particular combination of enterprises giving the best opportunity for an individual farm is closely determined by the physical factors affecting yields, the marketing factors determining prices, and the production factors and skill influencing costs of production. Choice of the main enterprise should be guided mainly by the facilities of the farm and the aptitude of the operator, recognizing the types of production which have proven generally successful for the area. Secondary crop enterprises should be selected mainly on the basis of their comparative yielding ability in the cropping system, the needs of the crop rotation, and the opportunity to fit in with effective livestock enterprises. The choice of secondary livestock enterprises, in turn, should be guided principally by the availability of feed and labor. Use of more specialized enterprises such as poultry, purebred livestock and seed crops should take account of the need for extra production skill.

Selection of the enterprise combination which seems best suited to the farm should be coupled with effective planning of the farm work program to allow each enterprise to be carried to its best size and efficiency. The long-run results of the combination will depend largely on how it is maintained in relation to price changes. Reasonable permanence of the enterprises to continue good production practices will usually be important to good success.

4. Getting Efficient Use of Labor, Power Equipment and Buildings

A good return from farming depends largely on a high labor return, which comprises the principal element of net income for the average farm. This involves efficient use of labor to give a high labor output, particularly for the fixed labor supply of the operator and farm family.

The main factors in good labor efficiency are a sufficiently large business to occupy the family labor, use of effi-

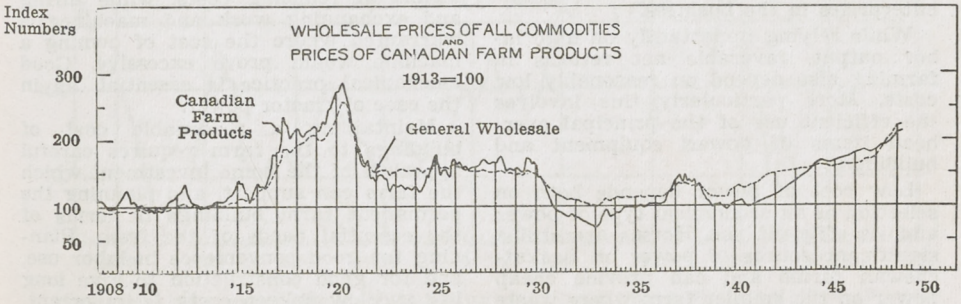


Fig. 1

Fig. 1.—Prices of agricultural products change more violently than prices of other commodities. In depressions agricultural prices fall fastest and farthest. In recoveries they usually rise more rapidly and to higher levels than other prices.

cient equipment, and desirable enterprise combination to make use of slack-season labor. In addition, effective planning of the farm work program to assure timely operation and handier distribution of labor is necessary for a high labor output. For livestock production more particularly, well-planned farm, farmstead and building layouts, and the use of handy labor-saving devices and time-saving work methods are important in efficient labor use. Where hired labor is necessary, good management and efficient use of hired workers become the important factors.

In crop production, available mechanical methods have greatly increased the capacity of labor. Hence efficient labor use depends mainly on the use of efficient equipment on a sufficiently large acreage. Livestock production, on the other hand, has been less adaptable to mechanical methods. Efficiency of labor has fallen behind that obtainable in cropping, and better labor use has become increasingly necessary to maintain satisfactory returns. Every means of improving labor efficiency in livestock handling should, therefore, be carefully considered for its possible application to the farm. Use of larger enterprises with their normally greater labor economy will usually prove desirable. Adoption of newer mechanical methods of feed handling, and the many forms of handy labor-saving devices, will often be beneficial. Better arrangement of feed and pasture areas, feed storages, watering facilities and barn layouts, allows important savings of labor in many instances. In turn, there are many points at which the adoption of handier work methods in individual livestock operations will effect material labor saving. Combined with better production practices, such labor practices will often allow a significant improvement of returns and greatly strengthen the effectiveness of livestock enterprises in the business.

While relying importantly on high labor output, favorable net returns in farming also depend on reasonably low costs. More particularly this involves the efficient use of the principal overhead items of power, equipment and buildings.

Low cost of power depends both on selection of an economical type of power and its efficient use. Horses are still a significant source of power on Saskatchewan farms and can provide cheap power on the smaller farm where waste pasture is available and good conditions for feed production obtained. Where cheap pasture is not available, and where feed production is costly and uncertain, a good selection of tractor unit will usually give the most economical power. For moderate and larger acreages, horse power will usually not be economical. Reasonable use will require a high efficiency of operation and available labor for handling more than one outfit.

Efficient use of horse power for low-cost production requires timely handling of about 30 to 35 acres of cropland per horse in the park belt and 40 to 50 acres in the plains area. In addition, economical feeding, inexpensive stabling and low-cost replacement are required to maintain a reasonable cost of power to the farm.

Obtaining low tractor-power cost requires an effective operating period of at least 600 hours per year for the common gasoline unit, and 1000 hours for the larger gasoline and Diesel units. The handling of about 40 acres of cropland per drawbar horsepower in the plains area and about 30 acres in the park belt will usually be necessary for a good standard of efficiency. Where the workload of the farm cannot give the required efficiency, consideration should be given to selection of a lower-cost second hand unit and to possible custom work to reduce the cost of power to the farm. Additional considerations include careful selection of the kind of tractor for operating needs and fuel economy, use of efficient loads and speeds in operation, and good mechanical practice to give low upkeep and replacement costs.

Desirably low costs of farm machinery depend mainly on selecting machines which are adequate but not excessive for the needs and size of the farm, and which balance well with the power unit. Care must be taken to avoid duplication of machines doing essentially similar work. Use of custom work and second-hand equipment can be considered as means of reducing costs, while hiring and exchanging work and machines is warranted where the cost of owning a machine would prove excessive. Good mechanical practice is essential, as in the case of tractor power.

Maintaining a reasonable cost of buildings to the farm requires careful appraisal of the home investment which the farm can support, and planning the permanent farm buildings in terms of the essential needs of the farm. Planning for good convenience in labor use, and for good construction to give long life and low upkeep costs, is important. Where needs are temporary or uncertain, the use of temporary structures is advisable until longer-time requirements

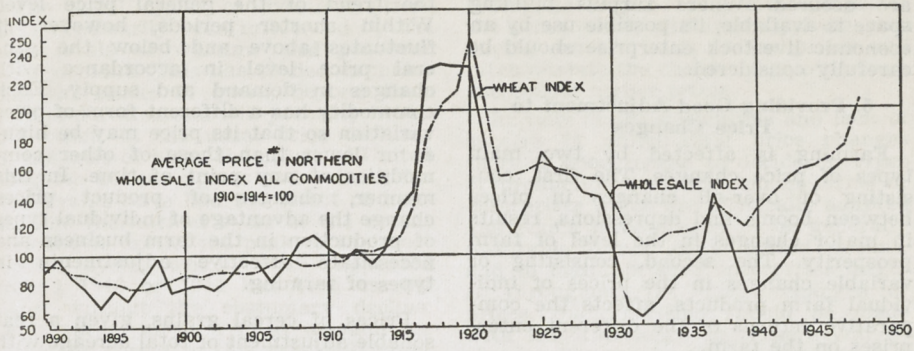


Fig. 2.—Over a long period of years the price of wheat tends to follow the trend of prices of other commodities. Beginning in the late twenties, the wheat index remained generally below the wholesale index. Since 1940 there has been a substantial recovery of wheat prices towards their normal relationship with other prices.
Wheat index for recent years represents initial Wheat Board payments plus participation payments announced to date.

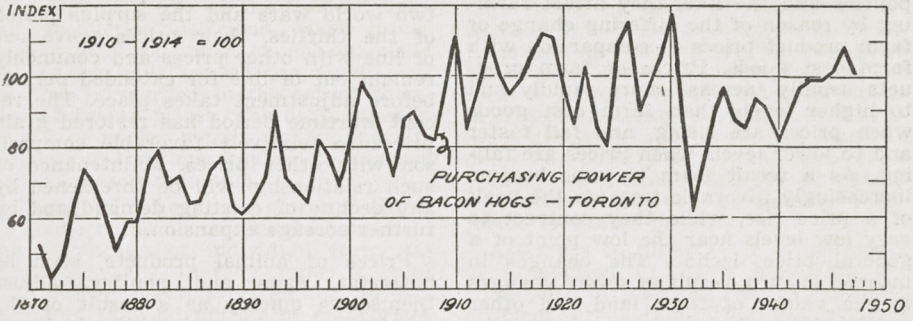


Fig. 3.—The cycle in the purchasing power of hogs has normally moved with 4 to 5 years between peaks. In recent years the cycle has been dampened by the influences of United Kingdom exports, feed grain policies and high domestic meat demand.

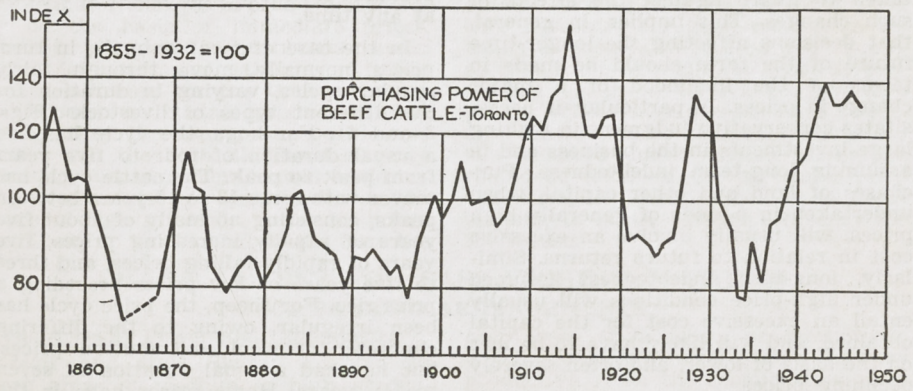


Fig. 4.—The purchasing power of cattle has moved in cycles with a duration of about 12 to 15 years between peaks. In the most recent cycle, the peak which was first approached in 1943 has been prolonged by exceptionally high wartime and post-war meat demand. The small decline of purchasing power in the latest year occurred in spite of an increase of cattle prices and reflects the sharp increase of other prices (Fig. 1).

are assured. Where surplus building space is available, its possible use by an economic livestock enterprise should be carefully considered.

5. Providing Good Adjustment to Price Changes

Farming is affected by two main types of price changes. The first, consisting of over-all changes in prices between booms and depressions, results in major changes in the level of farm prosperity. The second, consisting of variable changes in the prices of individual farm products, affects the comparative returns of the different enterprises on the farm.

Changes in the general level of commodity prices represent more or less violent upward and downward movements over generally long but varied periods of time (Fig. 1). Resulting from complex influences of wars, monetary policies and the like, they affect farming by reason of the differing change of farm product prices in comparison with farm cost goods. Prices of farm products usually increase more rapidly and to higher levels than farm cost goods when prices are rising, and fall faster and to lower levels when prices are falling. As a result farm incomes become increasingly favorable towards the peak of a price rise, while they contract to very low levels near the low point of a general price decline. The changes in income, in turn, result in severe changes in the values of farm land and other capital items.

By virtue of the large changes in incomes and capital values associated with general price movements, care must be taken to guard against the effects of such changes. This implies, in general, that decisions affecting the longer-time future of the farm should be made in terms of the likelihood of a major change in prices. In particular, it necessitates conservative judgment in making large investments in the business and in assuming long-term indebtedness. Purchases of land and other capital, when undertaken in periods of generally high prices, will usually involve an excessive cost in relation to future returns. Similarly, long-term indebtedness assumed under high-price conditions will usually entail an excessive cost for the capital obtained, and will likely have to be met on the basis of lower, and often severely declining prices.

Changes in individual farm product prices involve shorter-period changes. Over a long period of time the price of any commodity tends to follow the trend of the general price level. Within shorter periods, however, it fluctuates above and below the general price level in accordance with changes in demand and supply. Each commodity has a different form of price variation so that its price may be higher or lower than those of other commodities at any point of time. In this manner, changes of product prices change the advantage of individual types of production in the farm business and necessitate effective adjustments in types of farming.

Prices of cereal grains, given a reasonable adjustment of total acreage with demand, adjust themselves relatively rapidly, with irregular year-to-year changes of prices resulting mainly from variations of crop yields. On the other hand, under conditions where demand or acreage are generally out of line, as in the case of the shortage periods of the two world wars and the surplus period of the thirties, their prices move out of line with other prices and commonly remain out of line for extended periods before adjustment takes place. The recent wartime period has restored grain prices to relatively favorable comparison with other prices. Maintenance of such relationship will be threatened by any decline of existing demand and by further acreage expansion.

Prices of animal products, such as butterfat, eggs and poultry, adjust themselves quickly as a result of the rapid changes in production which are made in response to prices. Hence prices of these products rarely remain seriously out of line with the prices of other products for more than about two years at any time.

In the case of meat animals, in turn, prices normally move through fairly regular cycles, varying in duration for the different types of livestock (Figs. 3 and 4). For hogs, the cycle has had a usual duration of four to five years from peak to peak. The cattle cycle has moved with some 13 to 15 years between peaks, consisting normally of about five years of rapidly increasing prices, five years of rapidly falling prices, and three to five years of low prices preceding a price rise. For sheep, the price cycle has been irregular, owing to the differing character of wool and mutton prices, but has had a usual duration of seven to ten years. Horse prices have in the past shown a cycle of about 25 years duration, the peaks of which have recently been depressed by the widespread substitution of tractor power.

The usual cycles of livestock prices have necessarily been influenced by the high levels of wartime and post-war meat demand. This has tended to maintain the peaks of cycles beyond their normal duration and will probably lessen the extent of the usual price declines. In the case of hogs, the effect of United Kingdom bacon exports and policies for feed grains have had the effect of ironing out the normal cycle in the recent period. For cattle, the peak of the most recent cycle which first appeared around 1943 or 1944 has been carried along without the customary decline. Continuation of high meat demand for a further period in this case will probably prevent as severe a price decline as usually occurs in the downward phase of the cycle.

The cycles in livestock prices have occurred as a result of farmers over and under-producing, based on their judgment of prices at the time of making production decisions. High prices have caused too much expansion, while low prices have caused too much contraction in relation to the actual situation of future prices. The differences in length of cycles merely reflect the differences in the time required to increase and decrease production.

Changes in the prices of commodities as above result in continual changes in the advantage of individual farm enterprises. They thereby imply careful decisions in making production adjustments to take advantage of enterprises allowing the best returns. In so far as prices of products cannot be predicted accurately, and since they change over fairly short periods, it is rarely wise to make major changes in production merely on the basis of immediate prices. Rather, attempted adjustments should be made in terms of estimates of future prices, allowing for the time necessary to expand or curtail production, and recognizing the longer-run position of prices and the high likelihood of price changes. Thus, farmers should avoid being drawn into new enterprises on the basis of high prices, in so far as prices are likely to be changed by the time the enterprise is producing effectively. On the other hand, withdrawing from production on the basis of low prices will often obviate the chance of gaining from succeeding higher prices.

In view of the difficulties and lack of success in anticipating price changes there is good reason to decide on types of production for the farm in terms of enterprises which are physically adapted and which have proven to be generally profitable over a longer period of time, and to maintain such enterprises largely throughout the major changes of prices. Such decision should be made with the knowledge that there will be severe changes in the profitability of enterprises. However, it has the assurance of giving better results than a general "in and out" policy which is generally unsuccessful in outguessing price changes. Where a stable combination of enterprises is attempted, advantage should be taken of possible opportunities for making more limited adjustments in output for various price conditions. Such adjustments, in the form of increasing the number of litters in hogs, marketing older-age or finish-fed animals, or raising feeding levels in dairy and poultry production, can effect desirable short-time changes of output to prices which can be quickly readjusted to altered prices.

Attempts to make large adjustments of production to prices are often accompanied by losses in returns from less efficient production. This has perhaps been especially true of livestock enterprises, where "in and out" production and changing the size of herds have resulted in less attention to the grade of animal, feeding practice and production care necessary for good results. In relation to good farm returns it is equally as important to maintain efficient production as it is to realize favorable prices. Where over-expansion or excessive contraction of livestock enterprises has occurred due to prices, advantage should be taken of the particular price conditions for effective culling or herd-building to insure greater efficiency for the future.

SHARE LEASES FOR SASKATCHEWAN FARMS

CROP SHARING ARRANGEMENTS

Tenant Owns Power and Equipment:

Half and Half Share: Adapted to crop areas of medium or high productivity. Contains less risks for tenant than ⅓-⅔ shares. Especially adapted where yields fluctuate widely.

One-Third Two-Thirds: Adapted to crop areas of moderate productivity in which yields are fairly stable. In very productive areas the tenant often pays a share or all of taxes.

One-Quarter Three-Quarters: Adapted to soil areas of relatively low productivity and to farms which are poorly

improved. The tenant is often asked to assume a share of the taxes in areas which are intermediate between ⅓-⅔ areas and ¼-¾ areas.

Tenant Owns Neither Power Nor Equipment:

This crop share arrangement becomes unfavorable to the tenant on farms which are small or of low productivity, and in periods when yields or prices are seriously low. To offset such conditions the landlord is often called upon to assume an additional share of seed or the expense of equipment upkeep.

CROP SHARE LEASES FOR GRAIN FARMS

	Tenant Owns Power and Equipment					
	Share of Crop		Share of Crop		Share of Crop	
	Landlord 1/2	Tenant 1/2	Landlord 1/3	Tenant 2/3	Landlord 1/4	Tenant 3/4
Investment Contributions:						
Real Estate	All	....	All	....	All	....
Power (horses or tractor)	....	All	....	All	....	All
Equipment	....	All	....	All	....	All
Expense Contributions:						
Fire Insurance	All	....	All	....	All	....
Building Repairs	All	....	All	....	All	....
Fencing Repairs	All	....	All	....	All	....
Taxes	All	....	All	....	All	....
Hail Insurance	1/2	1/2	1/3	2/3	1/4	3/4
Seed	All	....	....	All	....	All
Twine	1/2	1/2	....	All	....	All
Threshing or Combining	1/2	1/2	....	All	....	All
Board of Threshing Crew	1/2	1/2	....	All	....	All
Labor	....	All	....	All	....	All
Power and Equipment Repairs	....	All	....	All	....	All
Feed for Work Stock or Fuel	....	All	....	All	....	All
Other General Expenses	....	All	....	All	....	All

	Tenant Owns Equipment but No Power		Tenant Owns Power but No Equipment		Tenant Owns Neither Power Nor Equipment	
	Share of Crop		Share of Crop		Share of Crop	
	Landlord 1/3	Tenant 2/3	Landlord 2/5	Tenant 3/5	Landlord 1/2	Tenant 1/2
Investment Contributions:						
Real Estate	All	....	All	....	All	....
Power (horses or tractor)	All	....	....	All	All	....
Equipment	....	All	All	....	All	....
Expense Contributions:						
Fire Insurance	All	....	All	....	All	....
Building Repairs	All	....	All	....	All	....
Fencing Repairs	All	....	All	....	All	....
Taxes	....	All	....	All	All	....
Hail Insurance	1/3	2/3	2/5	3/5	1/2	1/2
Seed	....	All	....	All	1/2	1/2
Twine	....	All	....	All	....	All
Threshing or Combining	....	All	....	All	....	All
Board of Threshing Crew	....	All	....	All	....	All
Labor	....	All	....	All	....	All
Power and Equipment Repairs	....	All	....	All	....	All
Feed for Work Stock or Fuel	....	All	....	All	....	All
Other General Expenses	....	All	....	All	....	All

Livestock share leases added to crop leases.—Where a landlord provides a herd of livestock, but where the tenant leases the cropland with his own power equipment, the sharing of livestock receipts may be combined with the ordinary crop sharing arrangement. If the crop lease provides for ½ and ½ shares, and if feed for livestock is set aside out of undivided crop (each party thereby providing half the feed) a half and half sharing of livestock receipts is an appropriate arrangement. If the crop share is only ⅓ to landlord, and if feed is provided from undivided crop, a 2/5 share of livestock receipts to landlord is more suitable.

LIVESTOCK SHARING ARRANGEMENTS

The following constitute reasonably satisfactory arrangements for sharing receipts from livestock where a landlord supplies a herd of foundation livestock to a tenant, who takes care of feed, housing, labor and ordinary cash expenses:

COMBINED GRAIN AND LIVESTOCK SHARE LEASES

	Power, Equipment and Productive Livestock Owned Half and Half		Power, Equipment and Productive Livestock All Owned by Landlord Tenant Provides No Capital.	
	Share of Total Farm Receipts and Livestock Increase		Share of Total Farm Receipts and Livestock Increase	
	Landlord ½	Tenant ½	Landlord ½	Tenant ½
Investment Contributions:				
Real Estate	All	....	All	....
Power	1/2	1/2	All	....
Equipment	1/2	1/2	All	....
Productive Livestock	1/2	1/2	All	....
Expense Contributions:				
Fire Insurance	All	....	All	....
Building Repairs	All	....	All	....
Fencing Repairs	All	....	All	....
Taxes	All	....	All	....
Hail Insurance	1/2	1/2	1/2	1/2
Seed	1/2	1/2	1/2	1/2
Twine	1/2	1/2	....	All
Threshing or Combining	1/2	1/2	....	All
Board of Threshing Crew	1/2	1/2	....	All
Labor	....	All	....	All
Equipment Repairs	1/2	1/2	....	All
Feed for Work Stock or Fuel	1/2	1/2	....	All
Feed for Productive Livestock (home grown or purchased)	1/2	1/2	1/2	1/2
Other General Expenses	1/2	1/2	....	All

pays the breeding fees. The tenant supplies feed and care for the herd and receives three-quarters of all sales of animals and products. Replacements to the herd are made out of normal increase. At the end of the contract period the landlord receives the equivalent, in age and number, of the animals originally supplied. Any animals above this amount are divided one-quarter to the landlord and three-quarters to the tenant.

Sheep: The landlord supplies breeding females and rams and the tenant provides the feed and care of the flock. The tenant receives 60 percent of all receipts (lambs and wool) if the flock is relatively young (average four years), and ⅔ of receipts for an older flock (six years or over). Replacements to the original flock are made out of normal increase. If the flock is expanded the landlord settles with the tenant for ewes added to foundation stock according to the shares used under the lease. The landlord is responsible for replacement of breeding rams and retains all receipts from sales of breeding rams.

Hogs: The landlord supplies bred sows and the tenant supplies feed, shelter and care. The landlord receives the cash value of one average finished hog from each litter. If desired, the value of the finished hog may be stated in terms of the average market price for a given month and grade. At the end of the contract the landlord receives his sows in good market condition.

MISCELLANEOUS

BEEKEEPING *

Beekeeping in Saskatchewan has developed as a farm sideline and as such seems to fit in best with other agricultural enterprises. Sideline apiaries vary in size all the way from one or two colonies to one or two hundred colonies per apiary. In addition to this, there is a growing number of commercial beekeepers whose entire time is taken up with their bees.

A large number of persons are becoming interested in bees as it is neither difficult nor expensive to commence beekeeping. Bees are no easier nor more difficult to keep than other forms of livestock and while experience is desirable it is not essential.

It is most important that a beginner commence in a small way, for it is necessary that the operator have a sufficient amount of knowledge concerning bees to be successful. This knowledge should be gained before much capital is expended. It is comparatively easy for a beginner to manage one or two colonies successfully but it is quite another matter when a start is made with a larger number.

Italian bees have proved the most reliable race of bees to keep, and about 98% of all the colonies in this Province are Italians. Caucasian and Carniolan bees have some adherents but these races have not been proved under our conditions.

Many types of equipment have been tried in the past, but the standard 10-frame Langstroth hive has proved superior. Beekeepers are advised to secure equipment of this size only, as work in the apiary will be much easier when one standard size of equipment is used.

Some beekeepers are trying to save money by making their own equipment. In most cases this is inadvisable as the average beekeeper cannot make his own equipment cheaper than it can be purchased, properly machined. Where equipment is made at home, great care should be exercised to have the measurements exact.

A beginner is advised to start with package bees and new equipment. In this way he is sure that his bees will be free from American Foulbrood infection.

Package bees are shipped in a wire-screen cage and come without hive, combs or supplies of honey, and all these must be given at once upon the arrival of the package. All package bees come from the southern United States where the seasons are earlier than in Saskatchewan. Packages do not carry disease and, therefore, their importation is not prohibited.

There are two popular-sized packages. The two-lb. package contains approximately 10,000 worker bees and a queen and the 3-lb package contains an additional 5,000 worker bees.

In an average year, the 2-lb. package if received early, builds up as rapidly and gives as good results as a 3-lb. package. For late May deliveries the 3-lb. packages are the better.

Package bee orders should be placed with a reliable shipper. Orders are filled in rotation and those received earliest receive first attention. Packages should arrive in Saskatchewan between April 15 and May 10. Packages arriving after the end of May seldom produce a satisfactory crop of honey the first season.

In addition to a package of bees, the following equipment will be necessary to establish one colony:

One standard Langstroth hive, consisting of a bottom board, brood chamber with 10 frames and a hive cover.

Two or three extra hive bodies fitted with ten frames each.

Five pounds medium brood, wired foundation (or, if unwired foundation is used, ¼-lb. No. 28 tinned wire) and one spur wire imbedder will also be needed.

One queen excluder.
One No. 1 bee-smoker.
One bee-veil.
One hive-tool.

A beginner needs neither an extractor nor an uncapping knife. The first season or two the honey may be cut out of the frames and eaten in the comb.

Most of our native flowers yield nectar which the bees gather. Willow, poplar, dandelion, wild fruit bloom, caragana, White Dutch and Alsike

*Prepared by the Provincial Apiarist, Department of Agriculture, Fort Qu'Appelle.

clover, mustard, wolf willow, sow thistle, golden rod, aster and many others are all nectar producers. Most of our nectar producing native flora bloom in the spring or early summer and are mainly important in building up the colonies. It is from sweet clover that 90% of the surplus honey is secured. In this, Saskatchewan beekeepers are fortunate, for their honey, coming mainly from one plant, is very uniform in color and flavor. Honey from sweet clover is among the best produced anywhere. It is characterized by a heavy body, that is, the honey is thick and rich; the color is light and the honey grades water white; the flavor and aroma are delicate and the granulation is smooth and fine.

Bees will fly long distances for nectar but for best results an acre of sweet clover (if left for seed) per hive, within two miles of the apiary, is considered necessary.

The per cent. infection of American Foulbrood in Saskatchewan bees has been kept at a very low point. In order to assist in maintaining this low per cent. infection, every beekeeper should promptly report any sign of disease among his bees. Equipment should not be traded or loaned and no equipment should be purchased secondhand unless it has been inspected by a qualified man and found free from infection.

Under the Apiaries Act, no used equipment may be imported into the Province and all persons keeping bees must register with the Bee Division. Beekeepers are urged to help enforce these regulations to protect their own and their neighbors' bees.

For the bulletin "Beekeeping in Saskatchewan" and for registration of apiaries, write to the Bee Division, Department of Agriculture, Fort Qu'Appelle, Sask.

KILL THE RAT*

The brown (or Norwegian) rat was first reported in Saskatchewan in 1912, when rats were observed in the village of Gainsborough just west of the Manitoba boundary in the extreme southeast corner of the Province. With the exception of a narrow strip along the west boundary, the Province is now overrun, the migration proceeding from the eastern to the western parts of the Province.

The rat is a great traveller and the situation is serious enough to call for active steps on the part of the public to stop the invasion and to destroy the rats in the invaded territory.

WHY THE RAT MUST BE DESTROYED

The rat is responsible for the spread of bubonic plague through the flea which infests the rat's fur.

Plague, or "black death" as it is frequently referred to, has killed 25,000,000 people in Europe. It is today prevalent in India, Asia and Africa and in recent years has been carried to the continent of America.

Canada has, so far, been immune from this dread disease, but if our country is to be kept free from the menace of plague every community must concentrate on the destruction of the rat pest.

Not only does the rat spread plague and other diseases but he destroys property, kills poultry and eats grain and merchandise. The yearly damage done by the rat in the United States is estimated at $200,000,000.

If our entire Province becomes rat infested the cost of the annual destruction to property and merchandise will be approximately $1,500,000.

HOW TO DESTROY THE RAT

The rat is one of the most cunning of animals and when we set out to kill him it is a case of measuring our wits against his.

One or all of the following methods of extermination may be employed: destroy his nesting places, deprive him of his food, trap, poison or asphyxiate him.

Ratproofing of Buildings.—Old dilapidated buildings should be demolished or so reconstructed that rats will not have access to them. The modern house or farm building erected on a concrete foundation two feet or more above the ground is rat proof, although special provision must be made at doors, windows and openings, to keep rats out.

Basement windows and coal chutes should be protected by wire screening of a mesh not greater than half an inch and the floor joists should be let into the basement walls to prevent rats from nesting between ends of joists.

*Sanitation Bulletin No. 5 of the Saskatchewan Department of Public Health.

Outside doors should be protected by a six-inch strip of metal at the base of the door and such doors should close automatically.

Frame buildings resting on the ground or provided with a dug-out may be rat-proofed by running a four-inch concrete wall around the building, two feet below and two feet above the surface of the ground.

In addition to nesting under the floors of buildings, rats burrow in the ground or under straw piles. Stacked flax affords both food and shelter for rats and stacks should be raised well above the ground.

Wooden sidewalks should be raised at least ten inches above the ground and so constructed that the rat's natural enemies may chase him out if he tries to seek cover.

Small farm outbuildings and summer cottages should be raised 24 inches off the ground on posts, the space beneath being left entirely open. Posts and sills for two feet on each side should be protected by metal sheeting to prevent rats from climbing.

Starving the Rats.—The rat is found where an abundant food supply exists. Look for him at slaughter houses, meat markets, hog pens, chicken houses, nuisance grounds and in and around garbage cans. Deprive him of the food that he gets at these places and he will be attracted by the bait in the trap.

If the municipal councils will see to it that the provisions of The Public Health Act and regulations are enforced in towns, villages and hamlets, the rat will go on short rations.

Hunting.—Dogs of the terrier breed such as Scotch, Irish and Fox terriers and Airedales are all good rat-hunters when well trained.

Other valuable allies to man in the hunting of rats are ferrets, weasels, skunks, foxes, coyotes, mink, and the larger hawks and owls.

Trapping.—The most effective trap for general use is the snap or guillotine trap, which should spring at the slightest touch.

These traps should be set in large numbers (scores if possible) in rat runs, at burrows and at places where rats feed. The bait should consist of some firm material such as fried bacon or tough meat and should be tied on so that the rat will be obliged to spring the trap.

Large cage traps can also be used with success.

Rats should become accustomed to the appearance of the traps for a few nights before they are set.

In warehouses and granaries large numbers of rats may be trapped by using a barrel, or garbage can, having a metal top which is carefully balanced. Bait is placed in the centre of the cover and the barrel either sunk in the ground or a plank laid from the ground to the edge of the barrel. The rat runs up the plank on to the smooth lid which tips and precipitates him into the barrel.

In all trapping operations the trapper must outwit the rat in his cunning.

Here are a few suggestions:

A new trap should be smoked or stained to make it appear much used.

When handling a trap or bait, gloves especially kept for the purpose should be worn, or if the bare hands are used they should be rubbed several times in earth before the traps are touched.

Do not use the same kind of bait too frequently, and if it is untouched after 48 hours destroy it and use a fresh bait.

See that all available food except the bait is removed. A rat will not be tempted to enter a trap simply by baiting the trap with more appetizing food than other food available outside.

The most suitable baits to use are sausage, fried bacon, oatmeal, toasted bread or cheese, fish, fish offal, fresh liver, raw meat, apples, carrots, corn sunflowers, squash.

Poisoning.—Although trapping is, for obvious reasons, preferable to poisoning, it is often found necessary to resort to poisoning, especially on a community scale. This method is receiving more attention recently because of newer types of poisons now available. Poisons are particularly applicable to organized community campaigns, and a community effort is the only one which is likely to be successful in an urban centre.

The older poisons, such as strychnine, arsenic and barium carbonate, are very poisonous to humans and, for that reason, are not recommended except in the hands of an expert. Red squill is a very effective rat poison and not nearly so dangerous to other animals or to humans. One of the newer preparations is known as Antu. It is also said to be less dangerous to man, but

highly effective against rats. Only small quantities are required, and it is placed in baits just as are other poisons. It may also be used in drinking water left for the rats. A mixture of 2 to 5 percent by weight is suitable. Baits may be prepared from meal, flour, fresh liver, raw meat, vegetables, such as carrots, cabbage, squash, fish and fish offal, and fresh fruit.

Poisoning should be adopted as a last resort because a live rat is preferable to an inaccessible dead rat on one's property. Furthermore, the handling and placing of baits requires care and a good knowledge of the habits of rats, if it is to meet with any success.

Asphyxiation.—The exhaust gas from an automobile which is known as carbon monoxide may be used to advantage for the destruction of rats and is very deadly in a confined space.

It may be used in field rat burrows or under a grain or hay stack by attaching a rubber hose securely to the exhaust pipe of the car. The other end is inserted well into the mouth of the burrow and packed with damp earth to prevent leakage of gas. All other possible exits from the burrow should be closed for the same reason. The engine is started slowly and increased to a speed of say 15 miles per hour and kept running for about 15 minutes.

The Saskatchewan Department of Public Health, Regina, will welcome communications regarding the prevalence of rats and the success attending their destruction in any locality in the Province.

CONTROL OF GOPHERS*

During the years 1945 and 1946, reports based on estimates by crop correspondents show that gophers caused a yearly estimated loss of 2¼% of the crop. Based on these estimates the total damage caused by gophers in the years 1945 and 1946 amounted to 15¾ million dollars.

Gophers are found in large numbers on waste or unoccupied land and it is not enough for a farmer to rid his own land of gophers since a fresh colony will immediately take possession from the waste land. The waste land, as well as the farm, must be attended to.

Some municipalities through their Agricultural Committees, have instituted a "Gopher Week" when the whole community makes a general attack on the gophers. This type of program gives much better results than when only occasional farmers are using gopher poison.

Poisoning of gophers is most effective when done early in the spring before the gopher has a choice of diet. The poisoned grain is not as attractive when an abundance of green vegetation is available. A small spoonful of poisoned grain should be put well into the entrance of the gopher hole. Poison spreading devices that can be purchased or hand made for attachment to machinery are useful. A trip line is fastened to the device which when pulled deposits a spoonful of poisoned bait. The use of this type of device on machinery in early spring is recommended where there is no danger of livestock picking up the poisoned grain.

The Saskatchewan Association of Rural Municipalities has an effective gopher poison known as "S.A.R.M." It is a liquid preparation containing strychnine and should be mixed with wheat or oats in accordance with instructions on the container. It can be obtained at most municipal offices in the Province. Local Improvement Districts usually secure their supply of poison through neighboring municipalities.

Sodium arsenite used in grasshopper bait is also effective in gopher control. Gophers take longer to die with the poison but they are killed nevertheless. After eating the poisoned grain, they become sick and crawl away into their holes to die. Sodium arsenite has been carried over from grasshopper campaigns in various localities.

The formula is as follows:

Sodium arsenite ..... ½ gallon
Water ..... 1½ gallons
Oats ..... 6 gallons or ¾ bushel

(a) Mix the sodium arsenite in water.

(b) Pour the solution over the oats and allow it to soak in for 24 hours.

Care should be taken in handling gophers and other rodents as they are known to carry various diseases which may be transmitted if a person is bitten

*Prepared by the Field Crops Commissioner, Saskatchewan Department of Agriculture.

or scratched or if the rodent comes into contact with abrasions on the exposed surface of the skin.

THE CONTROL OF POCKET GOPHERS

Pocket gophers are not uncommon in some areas of Saskatchewan. They are often mistaken for moles. The use of poisoned grain is not so effective against them as it is against the ordinary prairie gopher. Other baits have to be used. They may be destroyed by poisoning with strychnine, by trapping or by fumigation with carbon-bisulphide. It is also possible to destroy them by putting a rubber hose from the exhaust pipe of a car and running the exhaust fumes into the burrows of the gophers. The exhaust fumes will, of course, kill gophers just as they do humans. It would be necessary to open up the burrows so that the tube may be placed in the hole without any obstruction by dirt.

Carrots, parsnips, sugar beets or sweet potatoes cut into one-inch cubes and poisoned by the insertion of a few sulphate of strychnine crystals into a slit made by the point of a knife, are good, especially in the dry season when green food is scarce. Carry the poisoned cubes in an old covered pail marked POISON. Find the main run in the same manner as when setting a trap and with a slender pointed stick, so that you will not have to touch the bait, place one of the poisoned cubes a foot back in each hole, which should then be tightly closed. The hole may be opened 48 hours later and if it remains open the gopher may be considered dead.

LAND UTILIZATION POLICIES

The Saskatchewan Land Utilization Act is designed to bring about some improvement in the uses of land in Saskatchewan. Before explaining the Act and its use it may be helpful to review briefly a few facts regarding land settlement in Saskatchewan.

Many people came to this country during the early years of this century. Much of the country was untried agriculturally, and many of the new settlers were without farming experience under semi-arid conditions. This settlement soon occupied the open prairie sections, except the leased grazing lands and unoccupied parcels of rough, stony or very sandy land in the control of the Crown. But the tide of settlement turned. Many homestead entries were cancelled, and some homesteaders sold their property as soon as they had obtained title.

But it was not until the drought years of 1914, 1917, 1918 and 1919 that the real testing time came for many of the newly developed farms, as well as for many people, to whom the degree of reliability of their land was then indicated. These drought years brought distress and perplexity to such an extent that a Better Farming Conference was convened at Swift Current in 1920 to consider the suitability and value of the open plains area of Saskatchewan for agricultural settlement, and the development of means by which farming could be made more profitable and permanent, faced as it was by crop failure and the threat of drifting soils. This Conference recommended a survey of the soil resources of the Province. This was soon begun and the Soil Survey and the Economic Surveys have furnished much valuable data, useful in developing land use policies.

Shortly after the Swift Current Conference, the Dominion Government established an Experimental Station at that point, and intensive studies of grain growing problems in that part of Saskatchewan have resulted.

The Land Utilization Board under the Saskatchewan Act includes the Deputy Minister of Natural Resources, Municipal Affairs and Agriculture, a representative of the Local Government Board, the chairman of the Saskatchewan Assessment Commission, the Director of the Agricultural Representative Service and the Superintendent of the Lands Branch of the Saskatchewan Department of Agriculture, the Professor of Soils and the Professor of Farm Management of the University of Saskatchewan, the Director of the Prairie Farm Rehabilitation Branch of the Dominion Department of Agriculture, and the President of the Saskatchewan Association of Rural Municipalities.

The Land Utilization Board has sponsored the establishment of community pastures constructed by the P.F.R.A. in Saskatchewan. Title to certain lands considered unsuitable for grain production has been acquired by the Board under the Land Utilization Act. Municipalities are empowered to transfer title to inferior lands and lands which are highly susceptible to erosion to the Board, also to assign tax liens to the Board so that the Board

may acquire title to such lands if the arrears of taxes remain unpaid. In some cases the Board has exchanged land acquired under the Land Utilization Act for a clear title to private land. By using these means of acquiring title the Board has taken over blocks of land unsuitable for grain production but suitable and of sufficient size for community pastures for use by farmers in the surrounding districts who do not have sufficient summer grazing in their units to pasture livestock they could feed and care for during the winter. Community pastures organized by the Board are regrassed where necessary and water supplies developed. The use of the pasture by the farmer, at a fee to cover annual costs, provides a source of income to those who own cattle, and adequate supervision of the pasture and control of the grazing gives more stability to livestock production.

The Board has authority under the Act to prohibit the use of inferior land or land which is highly susceptible to erosion, for grain growing, in order to protect adjoining better land from soil drifting and to prevent the development of permanent "relief" areas.

One of the duties of the Land Utilization Board is to explore the situation as fully as possible in respect to all lands which, due to soil, climate or economic factors, are now, or are likely to become, unsuitable for grain production.

A considerable acreage of land unsuitable for grain production has been brought under cultivation. Parcels of such land are found in nearly all parts of the Province, and not only in the open prairie section. One of the duties of the Board, therefore, is the accumulation of information respecting lands in each Municipality and Local Improvement District which are not suited for grain growing. All such lands have potential value for livestock production, although it may be necessary to develop and improve them for this purpose through planting grass seed and by providing stock watering places.

It is obviously impossible to rectify overnight the mistakes of early settlement, but it should be possible with due regard to all facts, to introduce a measure of stability into farming operations which will accomplish worthwhile savings for the Municipalities which have been supporting people on unproductive lands during discouraging seasons, and to discourage further use of lands in the low productivity class for grain farming.

Briefly summarized, the policy of the Board is:

First: To develop a permanent agricultural program for the community.

Second: To obtain title to land in the low productivity class and then control its use so that the greatest benefit may be obtained from such lands.

Third: To develop the larger blocks of lands acquired by the Board into projects such as community pastures for which the blocks are considered to be more suited than for settlement and to have the smaller blocks acquired by the Board used in small projects such as community hay and grass seed lots or included, under lease agreement, in adjoining farm units where the land will be used for pasture or hay purposes.

WATER DEVELOPMENT

The development of the water resources that are available in the countless small streams and ravines in Saskatchewan is of particular importance. This development is taking place in the form of community irrigation projects and small irrigation schemes located on individual farm lands. By means of the development of storage facilities to "trap" the surface runoff it is possible for the farmer to impound enough water to irrigate from a few acres of land up to a few hundred acres on his own farm, depending upon the topography of the land and the amount of water available.

By means of irrigation the farmer has within his own control one of the principal factors of crop production. Hence, whenever it is possible to bring about this type of development on the individual farm it should be done. If there is a stream or ravine on the land which has a runoff during the spring months the individual concerned should contact his Agricultural Representative or make application to the Water Rights Branch, Regina, or direct to P.F.R.A. for the services of an engineer to determine the possibility of water development on his farm. This service is provided without any cost to the farmer. When the engineer locates the dam he will advise the individual as to the work he should do and the proper method of doing it.

On completion of the work to the satisfaction of the engineer or inspector, the Prairie Farm Rehabilitation Branch will pay to the farmer a certain sum per cubic yard of earth moved and for the purchase of certain structures that

may be necessary for delivering the water to the proposed land to be irrigated. A definite limit to the amount allowed in such cases is based upon the size of the project and the amount of work involved.

In addition to irrigation development, it is possible to have a dugout or stock watering project located on an individual farm and if the work done in constructing these projects is in line with the recommendations of the inspector, the farmer will be paid for the work he does on a basis of the number of yards of dirt moved up to the maximum amount as set by the Prairie Farm Rehabilitation Branch. In all of these developments, the principal object is to provide for the farmer in the area of Saskatchewan within which the Prairie Farm Rehabilitation Branch operates, a certainty of water supply for the use of his family and his livestock. Therefore, where it is possible to develop irrigation even to the extent of having enough water for a garden, this development should take place. Where it is possible to provide water supplies for a considerable acreage of land, it is possible for the farmer to supply not only his household requirements, but he can raise feed for his livestock, and perhaps some grain, even in the driest of years. Because of the security of crop returns that a water supply will give, every effort should be made to develop as many of these projects as possible.

Further information regarding this can be obtained by contacting your Agricultural Representative or by writing to the Prairie Farm Rehabilitation Branch at Regina, the Water Rights Branch, Department of Natural Resources, Regina, or the Department of Agriculture, Regina.

PRAIRIE FARM ASSISTANCE ACT

The Prairie Farm Assistance Act which was brought into operation in the year 1939, is intended to aid farmers in Western Canada in the years when low yields are experienced. The provisions of the Act are fairly well known to many Saskatchewan farmers as a considerable number have received awards during the years the Act has been in operation. While many amendments to the Act have been made since the original legislation was passed the spirit of the Act has not been altered and provides that in any crop year a farmer may be awarded a sum by way of assistance according to his cultivated land in a township. The basis of payment is on the cultivated acreage of the farmer and the extent of the payment is decided by the wheat yield. A township, which is six miles square and contains thirty-six sections, is the unit by which crop conditions are considered.

The Act is divided into three categories and the average yield of wheat for a township must fall into one of these three categories before being eligible for payment. If the average yield in a township is 0 to 4 bushels, the payment is $2.50 per acre with respect to half the cultivated acreage, not to exceed 200 acres. The maximum award in this category is $500. Also in this category a farmer in an eligible township who has 25 acres, or less than 160 acres of cultivated land, is eligible for a minimum award of $200. When the average yield is in the 4.1 to 8 category, payment shall be at the rate of $1.50 per acre on half the cultivated land not to exceed 200 acres or a maximum award of $300. There is also provision whereby farmers in townships with more than 8 and not more than 12 bushels per acre may be granted assistance when the price of wheat is less than 80c per bushel.

The following table shows the number of farmers and the total payments made in Saskatchewan:—

Year	Number of Farmers	Amount
1939	39,464	$ 7,574,890.68
1940	40,846	5,603,266.80
1941	62,473	12,010,772.42
1942	———	———
1943	22,000	5,037,598.87
1944	10,573	2,980,282.68
1945	43,425	12,542,042.16
1946	40,285	9,203,087.21
1947	52,463	12,773,776.25

A levy of one per centum is deducted from the net purchase price of all grain (wheat, oats, barley, rye) purchased by elevators or other grain dealers. The levy forms part of the fund used for the payment of awards to farmers. The following table shows the amounts contributed by Saskatchewan farmers through this levy.

Crop Year	Amount
Aug. 1/39 to July 31/40	$1,344,208.23
Aug. 1/40 to July 31/41	1,360,540.00
Aug. 1/41 to July 31/42	711,869.33
Aug. 1/42 to July 31/43	1,536,146.00
Aug. 1/43 to July 31/44	2,743,544.09
Aug. 1/44 to July 31/45	3,218,572.23
Aug. 1/45 to July 31/46	1,977,735.42
Aug. 1/46 to July 31/47	2,703,357.17
Aug. 1/47 to July 31/48	2,332,741.83

MEASUREMENTS, WEIGHTS, ETC. FOR AGRICULTURAL PURPOSES

HOW TO COMPUTE QUANTITIES OF GRAIN, HAY AND STRAW

Measuring Grain in Bins

The approximate number of bushels of grain in a bin can be found as follows:

1. Find the number of **cubic feet of grain** in the bin.
   (a) For square or rectangular bins, multiply the length of the bin by the width, and then multiply this by the average height of the grain, keeping all measurements in feet.
   (b) For round bins, take half of the distance across the floor, in feet—multiply this by itself, and then multiply by 22/7. This gives the area of the floor in square feet. Multiply this by the average height of grain in feet to get the number of cubic feet of grain.
2. Find the number of **measured bushels** of grain. To do this, multiply the number of cubic feet of grain by 8 and divide by 10. A little closer estimate is given by multiplying the number of cubic feet by 78 and dividing by 100.
3. Find the number of **bushels by weight.** For this multiply the number of measured bushels by the actual bushel weight of the grain and divide by the legal weight per bushel. Wheat weighing 65 lbs. per bushel will have 65/60 as many bushels by weight as measured bushels; oats weighing 40 lbs. per bushel will have 40/34 as many bushels by weight as measured bushels, etc. The bushel weight of grain can be determined by taking a sample to the local elevator.

Examples

1. Rectangular bin 12 feet long, 10 feet wide, with grain 8 feet high—wheat, weighing 63 lbs. per bushel.

Number of cubic feet of grain ..... $12\times10\times8=960$

Number of measured bushels ..... $\frac{960\times8}{10}=768$

Number of bushels by weight ..... $\frac{768\times63}{60}=806.4$ bushels

2. Round bin, 12 feet across. With grain 8 feet high—oats, weighing 40 lbs. per bushel.

Number of cubic feet ..... $\frac{6\times6\times22\times8}{7}=905$

Number of measured bushels ..... $\frac{905\times8}{10}=724$

Number of bushels by weight ..... $\frac{724\times40}{34}=851.8$ bushels

Measuring Hay and Straw in Stacks

The approximate number of tons of hay or straw in a stack can be found as follows:

1. Estimate the number of **cubic feet** in the stack.
   (a) For low, round-topped stacks, 10 to 15 feet high, add the width of stack in feet to the overthrow in feet and divide this by 4. Multiply the result by itself and then multiply by length of stack in feet.

   Example: Stack 20 feet wide, 45 feet long, overthrow 36 feet.
   Number of cubic feet—

   $$\frac{20+36}{4}\times\frac{20+36}{4}\times45=8820$$

   (b) For high round-topped stacks, 20 to 30 feet high, increase the result as in (a) above by six percent.
2. Find the number of **tons** in the stack by dividing the number of cubic feet in the stack by the number of cubic feet per ton as follows:
   (a) Alfalfa, sweet clover and wild hay

Days in Stack	Cubic feet per ton
30	548
60	520
90	504
120	492
150	480
180	472
240	456
300	440

   (b) Brome hay—allow about 25 percent more cubic feet per ton than in (a) above.
   (c) Straw—it requires at least 1200 cubic feet of well settled straw to weigh one ton.

Legal Weights of Saskatchewan Crops
(per bushel)

	lbs.
Wheat, alfalfa seed, clover seed, beans, peas, potatoes	60
Rye, flax seed, corn	56
Beets, carrots, onions, turnips	50
Barley, buckwheat, timothy seed	48
Parsnips	45
Hemp seed	44
Oats	34
Sunflower seed	24
Crested wheat grass seed	20*
Brome grass, blue grass and western rye grass seed	14

*No legal weight—usual weight for Saskatchewan.

Measures and Conversion Factors

1 Foot=12 inches.
1 Yard=3 feet=36 inches.
1 Rod=5½ yards=16½ feet=198 inches.
1 Mile=320 rods=1760 yards=5280 feet.
1 Link=7.92 inches.
1 Rod=25 links.
1 Chain=100 links=66 feet.
1 Mile=80 chains.
1 Square foot=144 square inches.
1 Square yard=9 square feet=1296 square inches.
1 Square rod=30¼ square yards=272¼ square feet.
1 Acre=160 square rods=4840 square yards=43,560 square feet.
1 Square mile=640 acres.
1 Cubic foot=1728 cubic inches.
1 Cubic yard=27 cubic feet.
1 Quart=2 pints.
1 Gallon=4 quarts.
1 Peck=2 gallons=8 quarts.
1 Bushel=4 pecks=8 gallons.
1 Imperial gallon=1.2 (6/5) U.S. Gallons.
1 U.S. gallon=0.833 (5/6) Imperial gallons.
1 Imperial gallon=0.16037 cubic feet=277 cubic inches.
1 Cubic foot=6.235 Imperial gallons.
1 Bushel=1.28 cubic feet.
1 Cubic foot=0.78 bushel.
Circumference of circle=diameter times 3.1416 (22/7).
Area of circle=square of diameter times .7854.
Surface of globe=square of diameter times 3.1416 (22/7).
1 Cubic foot water=62.5 pounds.
1 Gallon water=approximately 10 pounds.
1 Quart water=approximately 2½ pounds.
1 Pint water=approximately 1¼ pounds.

NOTE—Further tables on page 151.

THE AGRICULTURAL REPRESENTATIVE SERVICE

The Agricultural Representative Service consists of a field staff of 40 men. They are the Extension arm of the Department of Agriculture. In their districts they represent the three major agricultural services in Saskatchewan, namely the University of Saskatchewan, the Dominion Department of Agriculture and the Saskatchewan Department of Agriculture. This is made possible through the Saskatchewan Co-operative Agricultural Extension Program, which is headed by an Advisory Council. This Advisory Council consists of Representatives of the Saskatchewan Federation of Agriculture, a representative of the Saskatchewan Association of Rural Municipalities, a representative of the Saskatchewan Livestock Board, the Dean of Agriculture of the University, the Director of the Extension Department of the University, the Director of the Department of Women's Work of the University, a representative of the Dominion Department of Agriculture, the Deputy Minister of the Saskatchewan Department of Municipal Affairs, the Deputy Minister, Saskatchewan Department of Agriculture and the Director, Agricultural Representative Service.

To guide and advise the Agricultural Representative in an Agricultural Improvement Program in his district, Agricultural committees have been appointed by most Rural Municipal Councils. Each Agricultural Committee is charged with the responsibility of developing an agricultural program for the municipality, taking into consideration the land resources and the people living in the municipality. In the development of this program, the Agricultural Committee has the advice and counsel of the Agricultural Representative.

The Agricultural Representative has assistance available from many agricultural services. There is available from the central office a number of sets of slides. These are pictures of agricultural practices now being carried on by Saskatchewan farmers. There is a radio program which is closely co-ordinated

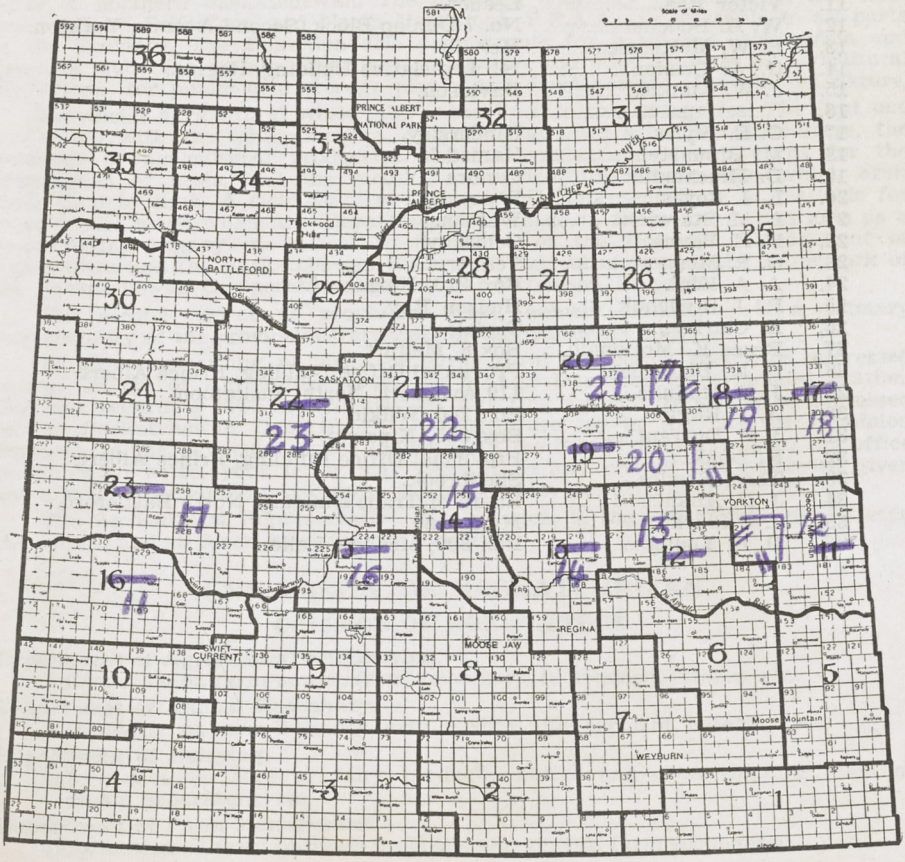
with the work of the Agricultural Representatives and the policies and programs of the Department of Agriculture and the research and demonstration work being done at the Experimental Farms and Stations and the University of Saskatchewan. There is a Farm Labor Division which assists in movements of farm labor under a Dominion-Provincial agreement.

From the Experimental Farms and Stations and from the University of Saskatchewan, specialist services are available. A specialist, for example, on soils can be made available for a special soil problem. The same would be true for other sections of agriculture.

The objective of the Agricultural Representative Service is a program of better land use, good husbandry and agricultural stability.

The Agricultural Representative is anxious to serve communities that wish to participate in such a program. Contact him through your Agricultural Committee man or direct at his headquarters.

AGRICULTURAL REPRESENTATIVE DISTRICTS



AGRICULTURAL DISTRICT SUPERVISORS AND AGRICULTURAL REPRESENTATIVES

as at September 1, 1948

Agricultural District Supervisors

Supervisory Area	Name	Address
S. E.	W. R. Merryweather	Drawer "Q," Indian Head.
S. W.	L. M. Ogilvie	Court House, Swift Current.
N. E.	T. A. Johnson	Box 8, Melfort.
N. W.	O. A. Cooke	119 Avenue F North, Saskatoon.

Agricultural Representatives

District No.	Name	Address
1.	H. M. Holm	Box 130, Estevan.
2.	D. H. Wilde	Ogema.
3.	W. L. Oddie	Assiniboia.
4.	G. H. Robinson	Eastend.
5.	J. E. Smith	Box 538, Moosomin.
6.	.....	
7.	A. M. Crowle	Box 925, Weyburn.
8.	G. A. Whiteside	453 Main Street North, Moose Jaw.
9.	P. W. Coolican	Court House, Swift Current.
10.	A. F. Shaw	Box 615, Maple Creek.
11.	Victor Rea	Leader.
12.	W. H. Boucher	No. 7 Dunlop Block, Second Avenue, Yorkton.
13.	E. W. McKenzie	Melville.
14.	G. A. Cushon	142 Legislative Building, Regina.
15.	J. W. Kunkel	Davidson.
16.	.....	
17.	O. E. Wyler	Kindersley.
18.	M. Brounstein	Kamsack.
19.	D. Hluchaniuk	Canora.
20.	L. J. Boyes	Wynyard.
21.	L. M. Stalwick	Watson.
22.	F. E. Payne	Colonsay.
23.	O. R. Mooney	Tessier.
24.	A. A. Kirk	Box 220, Kerrobert.
25.	R. J. Strilchuk	Hudson Bay.
26.	E. Clarke	Tisdale.
27.	Bruce K. McDonald	Box 8, Melfort.
28.	B. M. Blacklock	Provincial Office Building, Prince Albert.
29.	J. H. Maduke	119 Avenue F North, Saskatoon.
30.	A. J. Rugg	Box 240, Wilkie.
31.	J. B. Durrant	Box 335, Nipawin.
32.	R. Duck	Provincial Office Building, Prince Albert.
33.	Thos. Rowles	Shellbrook.
34.	J. F. Allan	Board of Trade Building, North Battleford.
35.	J. I. Clark	Maidstone.
36.	O. B. Young	Box 300, Meadow Lake.

SERVICES AVAILABLE

THERE are three main sources of agricultural information and assistance available to Saskatchewan farmers. These are the University of Saskatchewan, the Saskatchewan Department of Agriculture and the Dominion Department of Agriculture.

There are several important services provided by the Dominion Department of Agriculture in Saskatchewan and these can be listed in three general classes:

1. Protective and regulatory service.
2. Experimental and research work.
3. Development assistance.

The protective and regulatory services relate to such matters as health of animals (Animal Contagious Diseases Act), the grading and supervision of the marketing of agricultural products (The Livestock and Livestock Products Act, and other similar Acts), the regulation of the seed trade (The Seeds Act). These are listed in detail elsewhere. The administrative problems that arise in this field are either inter-provincial, national or international in their scope, which means that they should be handled by the Dominion Government. Under experimental and research work are included the activities of the four Experimental Stations and the research laboratories of the Divisions of Entomology, Botany and Forage Plants at the University of Saskatchewan. Under development assistance would fall the work of the P.F.R.A. and the P.F.A.A. The former is not operating in parts of northern Saskatchewan. The northern boundary running east and west lies north of Saskatoon and North Battleford. P.F.A.A. is applicable to all parts of the Province. The Dominion also pays grants for boys' and girls' grain and livestock clubs, for certain other junior activities and other features of agricultural exhibitions, for public cold storage plants and developments of a kindred nature.

Provincial agricultural work falls naturally into two categories. The first one has to do with the administration of provincial laws affecting agriculture, the guidance of agricultural production policies, conducting of campaigns for the suppression of pests, and the meeting of agricultural emergencies which arise from time to time. A field staff of Agricultural Representatives is available for most of the work which the Department has to do in the country, and acts as a co-ordinating agency in respect to the work of the Dominion Department of Agriculture and the Saskatchewan College of Agriculture under the framework of the Saskatchewan Co-operative Agricultural Extension Program.

The second aspect of provincial work, namely, education, is a primary responsibility of the provincial University or Agricultural College.

Inquiries concerning problems of agricultural production should be addressed to the College of Agriculture or to the nearest Dominion Experimental Station. Inquiries regarding laws and regulations affecting agriculture should be addressed to the Saskatchewan Department of Agriculture, or in the case of Dominion Services, to the particular office indicated in the list. If in doubt as to the office to which to write, your letter may be sent to any one of the addresses given and it will be forwarded promptly to the person best qualified to answer it.

The Agricultural Representative, for his area, is the connecting link between the farmer and all forms of assistance available.

UNIVERSITY OF SASKATCHEWAN

COLLEGE OF AGRICULTURE

Department of Agricultural Engineering.
Information on farm power, farm machinery, lubrication, hitches, etc.

Department of Animal Husbandry.
Information on farm livestock, care, feeding, management, breeding, etc.

Department of Dairying.
Information on care of dairy products, butter and cheese-making, care of cream separators, etc.

Department of Farm Management.
Information on farm business problems and general farm economics.

Department of Field Husbandry.
Information on farm crops, cultural practices, rotations, weed control, etc.

Department of Horticulture.
Information on vegetable gardening, fruits, flowers, horticultural pests, bee-keeping, etc.

Department of Poultry Husbandry.
Information on breeds, incubation, rearing, feeding, housing, etc.

Department of Soils.
Information on soil types, soil analysis, fertilizers, etc.

Department of Veterinary Science.
Veterinary laboratory services and information on animal diseases. See page 152 for details.

Department of Extension.
Directs the work of Agricultural and Horticultural Societies; provides judges for exhibitions and competitions; supplies speakers for short courses, farmers' meetings, and field days; organizes and directs the work of junior agricultural clubs, farm boys' and girls' camps and courses; distributes bulletins on farm questions; supplies specialists on specific farm questions for municipal committee and district board meetings and conferences on request of the Agricultural Representatives, and offers numerous other services.

Department of Women's Work.
Supervises the work of the Homemakers' Clubs and Homecraft Clubs, and provides information on problems of the farm home.

SASKATCHEWAN DEPARTMENT OF AGRICULTURE

Administration.

The overall administrative direction of the Department under the Deputy Minister covers personnel, policies, mail, money, accounting, grants, earned assistance, press releases, and such other matters as may pertain to agriculture.

Agricultural Representatives Branch.

Administers the Agricultural Representatives Act, and assists farm people with advice through meetings, visits, the press and radio in respect to the production of crops, livestock, poultry and bees, and all problems related thereto.

Organizes and conducts programs and activities designed to improve agriculture and rural living.

Provides services required in implementing the policies of the Department that provide assistance for production and marketing.

Correlates agricultural programs and activities within the framework of the "Saskatchewan Co-operative Agricultural Extension Program."

Apiary Branch.

Registration of Beekeepers.
Apiary Inspection.
Honey Grading.
Apiary Demonstrations and Winter Short Courses.

Dairy Branch.

Cow Testing Associations.
Organized Dairy Herd Improvement Associations.
Cream Grading Service.
Bonding and Licensing Dairies, Creameries and Cheese Factories.
Examining and Licensing Operators of the Babcock Test.
Inspection of Dairies and Manufacturing Plants.
Licensing and Inspection of Frozen Food Locker Plants.

Field Crops Branch.

Under forage crop program—sale of seed of grass-alfalfa mixtures for hay production.
Assists seed and crop improvement.
Organizes fodder and feed grain conservation programs.
Operates the Saskatchewan Government Seed Cleaning Plant, Moose Jaw.

Organizes insect control.
Organizes weed control.

Lands Branch.

The Lands Branch administers Provincial Agricultural Land within the surveyed area of the Province in respect to:

Granting titles for homestead entries and Dominion pre-emption entries and titles for lands purchased, including fractional and accrued areas.

Issuing of grazing and ranching leases and cultivation leases on a long term, short term or yearly permit basis; issuing hay permits on Crown lands.

Collecting hay and grazing fees, payments on sale contracts and cultivation rentals.

Assisting in making land appraisal surveys for the development of co-operative farms, co-operative and community grazing associations, and feed and fodder projects.

Management and operation of provincial community pastures and provincial dry or irrigated Crown land for feed and fodder projects.

Regrassing of misused land (over-grazed) pasture and inferior lands abandoned for farming.

Co-operation with the Dominion Veterans' Land Act and other departments in making available and in allocating Crown lands for the purpose of veteran rehabilitation.

The development of water resources by irrigation, drainage, reclamation and private ditches for use of farmers and water users.

Co-ordinating programmes and policies with the Land Utilization Board, Prairie Farm Rehabilitation Act, Ducks Unlimited, Municipalities, Agricultural Improvement Boards, and any other organization promoting conservation of water resources and wild life and fostering a land use policy.

Livestock Branch.

Enrolment and Licensing of Stallions.
Premium on Group Stallion Purchases.
Premium to Purchasers of Purebred Bulls.
Registration of Horse and Cattle Brands and Brand Inspection.
Organization of Purebred Sire Areas.
Dominion-Provincial Municipal Boar Policy.
Ram Distribution Policy.
Administration of Stray Animals Act.
Licensing of Livestock Dealers.
Licensing of Wool Warehouses, Wool Collectors and Wool Buyers.
Assistance to Swine Breeders in Advanced Registry.

Poultry Branch.

Licensing of Egg and Poultry Dealers.
Approved Poultry Flock Culling.
Pullorum Testing of Poultry.
Turkey Approval and Banding.

Statistics Branch.

Statistical Compilations and Surveys.
Secures Crop Information and Issues Reports.
Keeps Required Farm Implement Records.
Names of Homes Issuance and Registry.

Veterinary Branch.

Administers policies of the Department designed to assist in the prevention and control of animal and poultry diseases, see page 152 for details of the services available.

Milk Control Board.

Administers The Milk Control Act which determines prices of fluid milk sold in cities. The Board is an independent body and not a branch of the Department of Agriculture.

DOMINION DEPARTMENT OF AGRICULTURE

Experimental Farms at Indian Head, Scott, Swift Current, and Melfort, will supply information for the areas served by each, respecting farm crops, cultural practices, livestock, horticulture, fertilizers, etc., and cultural work of P.F.R.A.

Dominion Forest Nursery Stations, Indian Head and Sutherland, Saskatchewan.

Free Distribution of Trees for Farm Shelter Belts.

Dominion Entomological Laboratory, Indian Head, Saskatchewan.

Information on Shade Tree and Shelter Belt Insects.
Assistance in Controls.

Dominion Entomological Laboratory, University of Saskatchewan, Saskatoon.

Identification of Insect Pests.
Forecasts of Insect Outbreaks.
Information re Control of Insect Pests.
Assistance to Provincial Authorities in Conducting Control Campaigns.

Dominion Laboratory of Plant Pathology, University of Saskatchewan, Saskatoon.

Identification of Plant Diseases and Information on Methods of Control.

Dominion Forage Crops Laboratory, University of Saskatchewan, Saskatoon.

Information Relating to All Phases of Forage Crop Production.

Dominion Economics Division, University of Saskatchewan, Saskatoon.

Research work is conducted in Land Utilization, Farm Management and Marketing of Agricultural Products.
Information pertaining to studies made is available on request.

Dominion Soil Research Laboratory, Swift Current, Saskatchewan.

Research work is conducted in regard to soil fertility, soil erosion and soil moisture.

Information pertaining to these problems supplied upon request.

Health of Animals Division, Regina.

Investigation and eradication of certain Contagious Diseases of Animals.
Testing of Cattle for Tuberculosis—Accredited Herds; Supervised Herds; Restricted Areas.
Control of Scheduled Diseases, such as Glanders, Hog Cholera, Mange, etc.
Bang's Disease (voluntary policy).
Inspection and Testing of Animals for Export.
Inspection of Animals, Animal Products and Feeds Imported into Canada.
Control of Veterinary Biologics Imported into Canada.

Livestock and Poultry Division, Regina, Saskatoon.

Swine Improvement Policies.
Advanced Registry—Swine.
Federal Aid to Horse Breeding.
Bull Loaning Policy.
Record of Performance—Dairy Cattle.
Record of Performance—Poultry.
Sheep Improvement Policies.

Plant Products Division, Saskatoon.

Enforcement of the Seeds Act, Feeding Stuffs Act, Fertilizers Act, and Agricultural Pests Control Act.

Inspection of Registered and Certified Seed, Binder Twine and Hay and Straw.
Seed Production.
Seed Testing for Purity and Germination.
Seed Grading.

Plant Protection Division, Estevan.

Inspection of Imports and Exports of Plants and Plant Products for Insect Pests and Plant Diseases, and Seed Potato Certification in Southeast Saskatchewan.

Livestock Inspection and Grading Services.—Representatives at Moose Jaw, Regina, Prince Albert, Saskatoon.

Hog Carcass Grading Service.
Beef Grading Service.
Stockyard Supervision.
Market Information.

Poultry.—Representatives at Regina, Saskatoon, Yorkton.

Egg and Poultry Grading and Inspection.
Market Information.

Prairie Farms Rehabilitation.—Head Office, McCallum-Hill Building, Regina, Saskatchewan.

Administration of Prairie Farms Rehabilitation Act, including Water Development and Land Utilization.

Prairie Farm Assistance.—Head Office, Regina.

Administration of the Prairie Farm Assistance Act and the Wheat Acreage Reduction Act, 1942.

REGISTRATION OF PUREBRED ANIMALS

The registration of purebred animals of all breeds, Holstein-Friesian excepted, is centralized in the National Livestock Records, Ottawa. Correspondence concerning the registration of Holstein-Friesian cattle should be directed to the Secretary, Holstein-Friesian Association, Brantford, Ontario.

Registration of Purebred Animals

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MORE detailed information than that given in the Guide is freely available on request. Enquiries concerning problems of agricultural production and general management should be addressed to the nearest Agricultural Representative Office (see page 172) or to the University of Saskatchewan, Saskatoon, or to the Dominion Experimental Station at Indian Head, Melfort, Scott or Swift Current. Enquiries regarding laws and regulations affecting agriculture should be sent to the Saskatchewan Department of Agriculture, Regina, or in the case of Dominion Services, to the particular office indicated in the list given on pages 174 and 176. Letters relating to special problems, such as plant diseases, insect pests, etc., should be sent to the addresses indicated in the corresponding sections of the Guide.

If doubt is felt as to the office to which to write, your letter may be sent to the nearest Agricultural Service. If necessary it will then be forwarded promptly to the person best qualified to answer it. All are co-operating in the endeavor to give the farmer the best information and service that is possible, and letters—or personal visits where possible—in regard to individual problems, will be welcomed by agricultural workers.